THE NATURE-STUDY REVIEW

A JOURNAL
DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

MONTHLY, EXCEPT JUNE, JULY, AUGUST

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CONTENTS

	PAGE
The Evergreens. Illustrated. ANNA BOTSFORD COMSTOCK	1
What to Teach in Nature-Study. L. A. HATCH	13
Gold-Fishes in Japan. K. MITSUKURI	17
Definite Problems in Nature-Study. S. B. SINCLAIR	21
A Simple Experiment on Spontaneous Generation. F. L. STEVENS	26
Sunflowers for Gold-Finches. DELIA M. HALE	30
Science and Nature-Study Parallel. W. M. HALLOCK	31
Scientific Nature-Study, Abstract. M. A. BIGELOW	35
Editorials	36
Questions and Answers	37
Nature Notes	38
News Notes	40

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THE NATURE-STUDY REVIEW

CONTENTS OF No. 1, JANUARY, 1905

Nature-Study and Natural Science—A Symposium, H. W. Fairbanks, C. F. Hodge, T. H. Macbride, F. L. Stevens, M. A. Bigelow. Physical Nature-Study, John F. Woodhull. Nature-Study and Elementary Agriculture in Canada, W. H. Muldrew. Some Recent Criticism of Nature-Study, F. M. McMurry and H. E. Armstrong. Agriculture in Southern Schools, C. W. Burkett. School-Gardens at Hartford School of Horticulture, H. D. Hemenway. Ant-Nests for Schools, Adele M. Field. Guide to Periodical Literature, Ada Watterson.

CONTENTS OF No. 2, MARCH, 1905

Educational Values and Aims of Nature-Study, S. Coulter, H. W. Fairbanks, M. A. Bigelow. Principles of Nature-Study, J. M. Coulter. Children's Gardens at Worcester, Mass., Illustrated, Edna R. Thayer. Why Some School-Gardens are Failures, T. R. Croswell. Chemical Tablets for Feeding Plants Growing Without Soil, Illustrated, Edward F. Bigelow. A Nature-Study Lesson with Moulds, F. L. Stevens. Nature-Study in High Schools, M. A. Bigelow. Guide to Periodical Literature, II., Ada Watterson.

CONTENTS OF No. 3, MAY, 1905

Why Many Fail in Teaching Nature-Study, L. A. Hatch. Ready-Made Lessons in Nature-Study, L. C. Miall. Flower Shows in City Schools, Alice R. Northrop. Observation Bee-Hive for the Schoolroom, Anna Botsford Comstock. Window Gardens for the Schoolroom, H. D. Hemenway. A Wild-Flower Garden, Isabella G. Diggings. Making a School Lawn, Margaret T. Brown. Time Required for Nature-Study, S. B. Sinclair. Method of Sherlock Holmes in Nature-Study, E. A. G. Lamborn. Original Observations from Elementary Schools. Guide to Periodical Literature, III, Ada Watterson.

CONTENTS OF No. 4, JULY, 1905

Nature-Study versus Agriculture, W. M. Hayes. Nature-Study and Agriculture, Anna Botsford Comstock. Nature-Study and Agriculture, F. L. Stevens. Nature-Study in School of Nova Scotia, A. H. MacKay. Teaching Facts in Nature-Study, John Dearness. Nature-Study and its Relation to English, W. M. Heiney. The Silk-Worm for Nature-Study, Alvin Davison. Protective Colors of Animals. Facts Discovered by Children, T. D. A. Cockerell. Guide to Periodical Literature, IV., Ada Watterson.

CONTENTS OF No. 5, SEPTEMBER, 1905

Relation of Geography to Nature-Study, with Complete Outline of Courses for Eight Grades, H. W. Fairbanks. Value of Knowing Names of Natural Objects, Many Writers. An Educational Bee-Hive, Edward F. Bigelow. Do Birds Eat Butterflies, T. D. A. Cockerell. School-Gardens in Philadelphia. School-Garden Notes, H. D. Hemenway. A Plea for Wild Flowers. An Appeal for the Birds. Nature-Study in New Zealand. Nature Notes.

CONTENTS OF No. 6, NOVEMBER, 1905

The Communal Life of Ants, Illustrated, Adele M. Fielde. Study of Deciduous Trees in Winter, Clarence M. Weed. The Children's School Farm in New York City, Illustrated, Fannie Griscom Parsons. Temperance Physiology Sixty-six Years Ago, M. A. Bigelow. Plants That Hide from Animals, M. A. Bigelow. Facts Discovered by Children, Marion H. Carter. Guide to Periodical Literature, Ada Watterson Yerkes.

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THE
NATURE-STUDY REVIEW

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

VOL. 2 JANUARY, 1906 NO. 1

THE EVERGREENS

BY ANNA BOTSFORD COMSTOCK
Cornell University

[EDITORIAL NOTE.—The following paper is based on a leaflet prepared in 1904 for use in the Cornell Home Nature-Study Course, directed by Mrs. Comstock. The original leaflet was limited to the trees of New York. It is now arranged for Eastern North America, and the general plan will be valuable for teachers wherever evergreens grow.]

"Spite of winter, thou keep'st thy green glory,
Lusty father of Titans past number!
The snow-flakes alone make thee hoary,
Nestling close to thy branches in slumber,
And thee mantling with silence."

—LOWELL

Not only are the evergreens among our most useful and valuable trees, but they are also most beautiful to look upon; in the winter they give us masses of color in the snowy landscape, and in the summer they add great richness and beauty to the hues of the woodlands. These evergreens are the aristocracy of the tree world: they represent the oldest families, for members of the group to which they belong appeared as early as the Silurian age; the evergreens were probably at their height in numbers of species and magnificence of development during the Triassic period. The pines were contemporaries of all those plants which were put to sleep in the Devonian age, in our coal beds of today. The evergreens are a dignified remnant of an older tree-race, which is being pushed to the wall by those upstarts, the oaks and maples and other deciduous trees. They still cling to the sandy shores where there is little to support other trees; and to the mountains and northern regions where other trees have not the strength to endure.

Perhaps it is because they belong essentially to another geologic age when the climate was far different than our climate of today, that they do not shed their leaves in winter like the adaptable deciduous trees.

There are so few of the evergreens in any locality that it is easy to learn all the species present, and in this lesson we will study those species most common in the Eastern United States. We shall discuss the pines, the tamaracks, the spruces, the cedars, the firs, and the hemlocks.

There is one fundamental difference between the evergreens and other trees, which has given rise to some hard botanical names. The ovule is a little body that by the help of pollen ripens into a seed. Most plant species, like the apples, the maples, the sweet-peas, etc., have these ovules in a closed receptacle, which is called the ovary where they ripen protected. Such plants are called Angiosperms, which means "hidden seed." The cone-bearing plants or evergreens bear these ovules naked, simply lying between the scales of the cones, and they are called "Gymnosperms," which means "naked seed."

Lesson on Evergreens—How do evergreen trees grow? What is the leader? How does each year's growth affect the height of the tree and length of branches? If a branch on a tree is ten feet above the ground now will it be still higher twenty years from now? Do evergreens shed their leaves? When? Is the vegetation under evergreen trees the same as under deciduous trees? Why? What is a cone? What is its shape? What sort of a flower is a young cone? How many scales are there in the cone you are studying? Show by a sketch or description the shape of one of the cone scales and its markings? How are these scales arranged in the cone? Where are the seeds in the cone? How are they distributed? How are the evergreens useful to birds?

TABLE FOR DETERMINING OUR COMMON CONE-BEARING TREES

A. Leaves drop off in winter. Larch.
AA. Leaves remain on trees all winter.
B. Leaves in bundles enclosed in a short sheath at bottom. Pines.
BB. Leaves opposite or in whorls.
C. Spray flat. Arbor-vitæ or White cedar.
CC. Spray four sided. Red cedar.
BBB. Leaves alternate scattered along the stem.
C. Winter buds covered with resin looking as if varnish had been brushed over them. Leaves flat. Fir.
CC. Winter buds not resinous.
D. Leaves four sided. Spruce.
DD. Leaves flat.
E. Whitish beneath, short, flat, blunt. Hemlock.
EE. Leaves lighter green underneath, longer, pointed. A low shrub. Yew or Ground Hemlock.

THE LARCH OR TAMARACK

The larches are most graceful and beautiful trees forming slender pyramids often one hundred feet in height. Our native species seems to thrive in the high, cold swamps, and may be found in quantities about the margins of our Adirondack lakes. It has many, long tough, fibrous roots which especially fit it for life in swampy ground. The larch spray is exceedingly beautiful, as the leaves are attached in whorls to little knobs along the the side of a branch. In the European larch, which is commonly planted as an ornamental tree there may be forty or fifty of the needle-like leaves attached to each one of these knobs, which is really a twig shortened to about one-eighth of an inch; the spray thus has a tufted appearance, each long, terminal twig looking as if it were decorated with fluffy tassels. In the autumn the leaves turn a dull "old-gold" and fall to the ground, which is a very unusual performance on the part of the leaves of a cone-bearing tree.

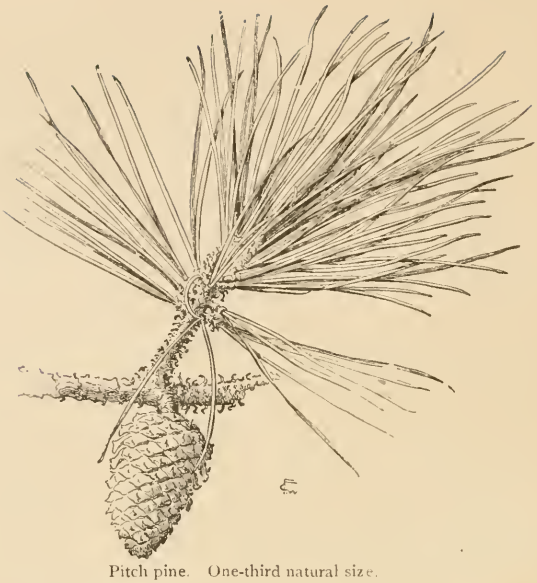
Lesson on the Larch or Tamarack—Describe or figure the cones, giving size, color and shape. Do they grow at the tip or along the sides of the branches? Do they stand up or hang down? What is the special value of the tamarack wood? Why is it used for water pipes? What does Longfellow say about the larch in Hiawatha? If you have ever been in a tamarack swamp describe it.

PINES

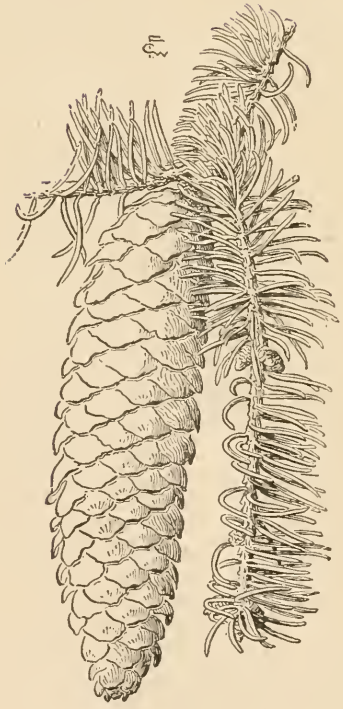
Among all of our tree friends the pines are the most companionable, for they are the only ones which habitually condescend to conversation. I have several friends among the pines, and each has its own tone of voice and tells a different story; and one rarely speaks at all. Aside from being friendly trees, the pines are most interesting as subjects of study. The arrangement of their tasseled leaves, and their mathematically tessellated cones, their whorled branches and mighty roots spreading far on each side, afford inviting subjects for study. If we live in a land where stump fences abound then we have excellent opportunities for studying the great underground system of these splendid trees. The pines require at least two seasons for maturing their cones, differing in this respect from the other evergreens.

There are in the Eastern United States nine very common native species of pines and two European species which are commonly planted. Our native species are: The Labrador or gray; the Canadian or red (Pinus resinosa); the white (P. Strobus); the pitch or torch (P. rigida);

Cone of pitch pine. One-half natural size. The seeds have been shed.



Pitch pine. One-third natural size.

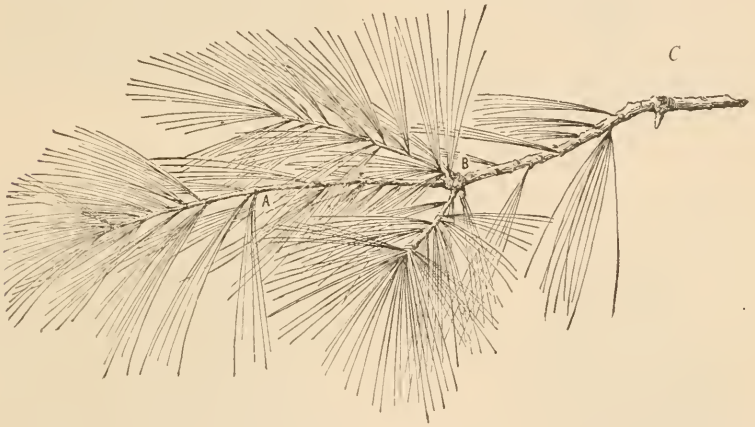


Cone of Norway spruce. Half size.

Cone of white pine. It has shed its seeds. Half natural size.

the Jersey scrub (P. Virginiana); the table-mountain or hickory (P. pungens); the spruce or the yellow pine of the east; the long-leaved or Georgia (P. palustris); and the loblolly or old-field (P. Tæda).

In north-eastern America from New Brunswick west to Manitoba and south to the northern parts of the United States are found the Canadian or red pine, and the Labrador or gray pine. The latter is a slender tree usually not more than sixty feet in height, while the red pine often reaches the height of one hundred and fifty feet. The leaves of both of these pines are arranged two in a sheath, but the species are easily distinguished by the position of the cones. In the red pines the cones are at the tips of the branches or very near the tips, while the cones of the gray pine grow along the sides of the branches.



Shoot of the common white pine, one-third natural size. The part of the branch between the tip and A is the last season's growth; from A to B is two years; from B to C is three years' growth.

In New England and the middle states, the commonest species are the white pine, pitch pine, Jersey or scrub pine, and in the southern portions the table-mountain or hickory pine. The red pine also grows as far south as Pennsylvania but is not very common. The white pine is the most graceful and beautiful of our pine trees; its long, fine, grayish-green needles are arranged five in a sheath; its cones are long and slender and are borne near the ends of the the branches. The pitch pine has coarse, yellowish-green and bushy foliage; the needles are arranged three in a sheath and its cones are along the sides of the branches.

The Jersey scrub and the table-mountain pines both occur from

Red Pine.

Norway Spruce.

White Pine.

White Pine and Hemlock. Note difference in bark.

New Jersey to North Carolina. Both are slender trees usually not more than forty to sixty feet in height; both have the leaves arranged two in a sheath, but the Jersey scrub grows in sandy soil along the coast, while the table-mountain grows in the forests in the regions of the Alleghanies. The cones of the table-mountain pine are four or five inches long, while those of the Jersey scrub are rarely more than two and a half inches in length.

The species most common in our southern states are the yellow or spruce pine, the long-leaved or Georgia pine, and the loblolly or old-field pine; all of them grow on sandy soil and form scattering forests. The yellow pine is readily distinguished from the other two because its leaves are three to five inches in length; the yellow pine also has its leaves arranged two in a sheath. Both the loblolly and the long-leaved pines have very long leaves, those of the loblolly being from six to ten inches long and those of the long-leaved from ten to sixteen inches in length. The leaves of these pines are arranged in threes, but the cones of the long-leaved pines are at or near the ends of the branches, while the cones of the loblolly are along the sides of the branches.

Two European species very commonly planted in our parks and grounds are the Austrian and the Scotch pines. The Austrian has long, stiff leaves and is a handsome tree which resembles our native red pine, except that its leaves are more pointed, much less flexible and larger in diameter. It is hardy in this climate, and since it is so generally planted in parks and grounds, it affords a fine opportunity to the study of the flowers and pollination during the last of May or early June. The Scotch pine has such short, flat leaves that it has been miscalled Scotch fir. Its leaves scarcely ever exceed two inches in length, and are broad, flat and flexible.

Lesson on any Pine in your Locality—What is the general shape of the tree, and where does it grow? What is the shape of the cone? What is the character of its bark? How long are the needles, and how do they compare on length and thickness with any other species of pine in your locality? How many needles grow together in a bundle? Is this bundle enclosed in a little sheath at the base? (In the white pine the sheath drops off very soon.) Are these bundles grouped in distinct tassels, if so, how many constitute a tassel? What shade of green is the general color of the foliage? Cut a pine needle in two and look at the end with a lens, and note its shape. The white pine differs decidedly from others in this particular. How can you tell this year's from the last year's and from next year's cones? How old is the cone when it opens and scatters its seed? How many seeds are there under a single cone scale? How many kinds of flowers does the pine tree have and where are they borne? How is the pollen

carried? Which is the most important commercially of our pine trees? What is the pine wood used for? What is resin? Of what use is it to the tree? To the cone? What is the difference between resin and rosin?

THE CEDARS

Under the name of cedar we have three species which belong to three different genera. The arbor-vitæ often called white cedar, the southern white cedar and the red cedar.

Arbor-vitæ—This is a common hedge tree, and its flat foliage is very beautiful when examined carefully through a lens. It looks as if it had been pressed with a flatiron. The arbor-vitæ grows in wet places, as well as along streams where it makes almost impenetrable forests. In the Adirondacks it grows at an altitude of 3,500 feet. The southern white cedar may be distinguished from the arbor-vitæ

The Arbor-vitæ. Nearly full size.

by the fact that the tips of its branches are not more than 1-16 inch in width, and that its cone is a little knobbed ball.

Lesson on the Arbor-Vitæ—Take a twig, remove the leaves and describe their relation to the twig. Draw a bit of the spray showing the shape and arrangement of the leaves. Use a lens for this. Are you acquainted with the arbor-vitæ as a separate tree or in hedges? How many scales are there in the cones and where are the seeds borne? What is there about the foliage and the way it grows that fit it for a hedge plant?

The Red Cedar—The twigs of this and their surrounding leaves have not been flattened as in the arbor-vitæ, but each little twig looks like a braid of green yarn. There are two kinds of leaves on the red cedar, the green leaves which overlap each other and which are seen at first glance, and some other pointed needle-shaped leaves not overlapping, which are often brownish and are not so readily

seen, but which you feel if you put your hand against the foliage. The fruit of the red cedar is a bluish berry.

Lesson on the Red Cedar—Describe the foliage of the red cedar giving the shape of the green leaves, as well as the sharply pointed ones. Is the spray of the leaf four sided or cylindrical? Describe the fruit carefully giving its color and form. How many seeds are there in each fruit? What is the wood of the red cedar especially used for?

BALSAM FIR

This is the only native fir tree common in the northern United States, though the silver fir of Europe is planted more or less in our parks. Whoever has been fortunate enough to have been in camp in the North Woods, and has reposed upon a bed made from the fragrant branches of this tree has something delightful to remember. And those who have not used the branches for a bed may have laid their heads upon pillows filled with the dried leaves of this beneficent and health-giving tree. The balsam fir is often planted as a shade tree, and is likely to be found in the yards of farm houses, rising a black and graceful spire far above the house top. This fir may be distinguished from the spruces by the leaves, which are flat and thin, and very blunt at the tip, and by the fact that the winter buds are protected by a coat of resin, which makes them look as if they were varnished.

In the Alleghany Mountains from Virginia to Tennessee, occurs Fraser's balsam fir which is very much like the northern species.

Lesson on the Balsam Fir—If you know the balsam fir describe it? Where does Canada balsam, the clear gum in which we mount microscopic objects, come from? How does it occur on the tree? How are the leaves arranged on the twigs, that is, do they project in all directions? When the tree grows in the open is the bole bare for any distance above the ground? How do the trees grown in the woods differ in this respect from those in the open.

THE SPRUCES

In the mountains of the Northeastern States these most valuable trees are common. There are three species, the white, the black and the red. The black spruce is so-called because its foliage massed against the mountain side looks black, whereas the white spruce is much lighter in color, being grayish-green. The cones of the white spruce are slender and elongated, being often more than twice as

long as wide, while those of the black and red species are much thicker in proportion. The red and the black species were for a long time considered one, and are regarded so now by lumbermen. However, the botanists consider them distinct. The cones of the red spruce fall during the first winter, while the cones remain upon the black spruce several years, and this is the chief way of distinguishing them. Birch beer is made from both the black and the red spruce, and chewing gum also. The white spruce has a disagreeable odor. The spruces have leaves which are four sided; in cross section one of these leaves is more nearly diamond shape than square. The cones hang down instead of standing up.

The Norway spruce is planted everywhere, and may be taken as our type for study. It is common in our parks and planted grounds, and is sometimes used for hedges.

Lesson on the Norway Spruce—What is the shape and length of the leaves? How many lengthwise ridges has each leaf? Are the leaves arranged all around the twigs? How in relation to the twig are the points directed? What is the shape, size and color of the cone? Where on the twig is it borne? Does it hang down or stand up? Figure or describe a seed. In the old trees do the twigs stand out all around the branches or do they hang down? How is this arrangement of the twigs on the branches useful to the tree in its native climate? Do the Norway spruces when standing in the open show any bole below the branches or do the branches grow to the ground?

HEMLOCK

There are but two species of hemlock in Eastern United States our common northern species and one that is found south in the Alleghany Mountains.

The hemlock during its youth and middle age is the most graceful and beautiful of all our evergreens, and in its old age it is the most picturesque. There is no prettier sight in all the tree world than a symmetrical, vigorous hemlock, when the new growth of vivid, light green tips every twig, making exquisite contrast to the dark, dull green of the older foliage. And there is no such picture of old age and loneliness as the old hemlock towering above its fellow trees with its upper branches bare and black extending helplessly toward the four winds of heaven. It is a pity that a disease has attacked our hemlocks in New York and is surely though slowly killing all that are mature. It is as if they were discouraged at the wanton destruction of their species by man and die rather than suffer the ignominy of the axe.

Lesson on the hemlock—Describe the tree. Do the branches extend straight out or droop at tips? Describe the foliage. Describe or sketch a hemlock cone. Are the cones borne at the tip or on the side of the branches? Does the cone mature in one season? Describe or sketch the seed. What industry has caused the destruction of the hemlock? For what parts of building construction is it used? What is its special value as building timber?

Ground hemlock—This is a low straggling shrub not more than four or five feet high, which has foliage resembling that of the hemlock, except that the leaves are longer and bright green on both sides. However, it is not a hemlock at all, but a yew and its fruit is a red berry.

Lesson on ground hemlock—In what direction do the branches extend? Is there a main stem? Is the berry edible? How is the seed distributed?

CORRELATION OF THE STUDY OF EVERGREENS WITH OTHER STUDIES

With history—In glancing across the wood covered hills of New York State one often sees stretching far above the other trees the gaunt top of an old, white pine. Such pine trees belonged to the forest primeval, and may have attained the age of two centuries or more; they stand there looking out over the world, relics of another age when America belonged to the red men, and the bear and the panther played or fought beneath them. The cedars live longer even than do the pines, often reaching the age of three hundred years.

Perhaps nothing so naturally turns the attention of the pupil to past events as the thought that the life of such a tree has spanned so much of human history. If you have one of these old trees in your vicinity make its life-history the center of a story of local history; let the pupils find when the town was first settled by whites, and where they came from; what Indian tribes roamed the woods before that, and what animals were common in the forests then. Bring out the chief events in the history of the county and township; when were they established and for whom or what were they named. What are the industries of the present village or township, and are they the same as they were a hundred years ago.

With geography—Where are the cone-bearing trees most numerous? To what climates and soils are they best adapted? Why? (Roth. pp. 32–40.) Where are the forests of cone-bearing trees found in America? (Roth p. 211.) How is the pine used to reclaim the sea-shore in France? (Roth. p. 198.) Is there a difference in the species

of conifers that live in Florida, and those of the Rocky Mountains and northern Michigan? (Roth. pp. 154–158).

With industrial geography—What is the difference between hard and soft woods and what are their uses? In building a house which of the evergreens are used for the timber and which for the floors and finishing, and where do they come from? Describe how and where the following industries are carried on : lumbering, wood-pulp, resin, making and use of turpentine, tar and tan-bark. Why is lumber so high priced at present?

With arithmetic—One branch of Austrian, pitch or white pine will be of as much use in teaching addition, subtraction, multiplication and division in the elementary grades as any apparatus ever devised by ingenious educators. In fact these leaves are grouped in 2's, 3's and 5's as if specially arranged for an arithmetic class. The cone also affords opportunities for counting and multiplying. If there are two seeds beneath each scale, how many are there in the entire cone, etc.? The cone itself when closed invites to higher mathematics, though I doubt if one trained in conic sections in college would be able to work out the mathematical relations of the scales to the cone.

For the older classes the measuring of trees affords a practical and delightful exercise in geometry. Any boy can construct with a jointed pocket rule an instrument for measuring the height of trees, as described in Roth p. 171. Calipers for measuring the thickness of trees can also be made by any ingenious boy. After measuring trees let the pupils compute the amount of lumber in each, using the log scale given in Roth p. 259. This will be a most useful and practical exercise for the older boys and girls.

With English—Read with your pupils the following poems or such parts as they will understand : *Spirit of the Pine*, by Bayard Taylor. *To a Pine Tree*, by Lowell. The work indicated in industrial geography gives interesting topics for essays.

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[*The illustrations used in this article are taken from the Cornell Nature-Study Leaflets.*]

HOW TO DETERMINE WHAT TO TEACH IN NATURE-STUDY

BY L. A. HATCH

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There is a general feeling concerning much of the work that passes as nature-study in our schools that it is somewhat fragmentary in its character and that it tends to lead to nowhere in particular. It is held that it concerns itself too much with a multitude of little things that are more or less unrelated. In the study of any topic, a few more facts tacked on here or there, or left out entirely, is of little concern. There is no feeling of loss or inconsistency by teacher or pupil. The big thing to do is to observe and gather data, hoping in the meantime that all will be well in the end. In fact, the more little things brought together, the more educative is the process thought to be.

Now, it is easy to fool one's self into thinking that such work contains the essential elements of value in the process of education. It breaks down in that it does not recognize the worth of discriminating as to relative values in dealing with the content side of nature-study. Like the farmer's hayrake, the scheme of teaching nature-study referred to gathers everything that is in the way—hay, thistles, last year's stubble, roots, etc., and all passes as "hay". As the farmer occasionally discards a "bull-thistle" or a root, so the teacher may occasionally discard a few of the noxious things, but as a rule all is garnered and labeled, "hay", "nature study", "educational food", "mental pabulum".

What is the matter? As has been indicated, no standard is used by which the relative worth of subject-matter is measured. There is no basis which serves as a guide in the selection of material. As a result the place of beginning and ending is not clearly defined, consequently the teacher rambles here and there in her teaching. Pupils bring to the recitation anything and everything and the teacher rejoices and is exceeding glad, because of the quantity. As a teacher, she is lauded and is pointed out as one having the ear-marks of an artist in the teacher's profession.

If you doubt the truth of what has been said, it is suggested that you quietly slip into several rooms where nature-study is being taught and measure the worth of the work. As you observe, ask yourself such questions as; What is the center of the recitation? Have teacher and pupils clearly defined their problems before making an attack? What is the aim that defines and unifies the work? What big things will stand out in the minds of the pupils when they have gone over this work? To some this test may seem to be a little formal to apply to the nature-study of the lower grades, but to the writer the work must bear this test if it is to be considered worth while.

Unless the teacher has pretty clearly defined in her own mind the port toward which she is sailing, her educational bark may tend to drift with the wind, to be carried hither and thither by counter currents and to find in the end that it has gotten into a belt of calms where starvation is inevitable. A clearly defined end in the recitation, vital in its relation to the child, is as essential to the teacher and her little crew in their voyages, as is the compass to the mariner who sails upon the broad ocean. To be more concrete, you doubtless may have seen what may be styled "an aimless" recitation in which the thought of teacher and pupils scattered over many little unrelated things, without accomplishing anything in particular of worth. The facts discussed had no binding thought to unite them and make them dynamic.

What can be done? Above all things consider the nature of the child who is to receive this instruction. Then consider the nature of the teachers who are to instruct the children. Finally consider the character of the subject-matter and the means by which the same is to be brought into living relation to the child.

Let us consider the third point mentioned for it is here that the teacher needs much help. We may think of it as falling under four heads, viz:

(1) The extent of the field of nature-study. (2) General principles that should guide in the selection of materials. (3) The course of study somewhat in detail. (4) The treatment of subject-matter.

Of these topics the second is most fundamental, in that our action concerning the others will be determined, in a large measure, by the way in which we answer this. When we have determined the principles upon which nature-study rests, we have a basis upon which to determine the extent of the field and what to put into our course of study, and what should be our method in dealing with individual topics.

The following principles are suggested as a guide in planning a course in nature-study: (1) A vital human relation should be found in all the work undertaken. (2) The course should contain within itself a rich content that is worth studying. (3) There should exist an intimate relation among the parts, holding the same together in such a manner that the work covered from year to year will be progressive and united.

If it does not bear an intimate human relation the element of interest will be lacking and the child will fail to see, to experience in the fullest measure, that which is presented. If nature-study does not contain a rich content within itself as a study, it will surely fall into disrepute as has been the case with every study where content has been lacking. If a relation which tends to unify the work does not exist, at least in a broad way, then the outcome must be necessarily more or less scattered and aimless.

If space permitted, it would be well to take a number of topics, such as are taught in nature-study, and apply the above principles to them to determine whether or not they should be retained or rejected in making up a course for nature-study. Instead of doing this a single topic will be discussed to illustrate what may be done in testing others to determine their relative value. The "Strawberry" will be discussed.

Let us first consider the value of this topic from a human standpoint. The strawberry is our earliest fruit, coming at a time to fill a decided human need. It is cultivated in all sections of the country. The fruit is easily preserved, thus making it possible to use it at all times of the year. It is considered to be one of our best flavored and most healthful of fruits. Enough strawberries may be raised on a small patch to supply a family—the writer picked 118 quarts from a patch 25 feet square during the past season. Many people make much of their living by raising and marketing strawberries. There are but few people who do not like strawberries. Many people make a business of supplying strawberry plants to those who wish to set out beds. Boys and girls may be led to set out strawberry beds at home through the work done at school on the "Strawberry."

In the second place there is much rich content centering around the strawberry and its cultivation. This becomes clear if its study is centered about an aim as: What do you need to know to make a success of raising and handling strawberries? Such topics as the following will be discussed under this aim: What varieties do best in the

section of the country studied? From where may they be obtained? How expensive are plants? Is it possible for us to raise our own plants? How are they propagated? How are new varieties obtained? Which varieties are self fertilized and which need to be fertilized by others? When should a strawberry bed be started? What kind of soil and drainage are best suited to the raising of strawberries? How should the soil be prepared? How should the plants be set out in a bed? What kind of cultivation should a strawberry patch receive during the year? What protection needs to be provided against drought? How should the bed be protected during the winter? What are the different coverings that may be used and what are the advantages or disadvantages of each? From what animals does the patch need protection? What plant enemies does one need to contend with and how may this be done best? How often does a new bed need to be set out? Why is this necessary? How is it possible to raise strawberries on the same patch of ground year after year and obtain good results? When and how often should straw berries be picked? How best put on the market? How handle the bed after the picking season? How much profit could one make from an acre of strawberries? What better work could be done in Domestic Science during the latter part of the spring term than to let the work center on the preparation of strawberries in various ways for the table? The subject of preserving and canning strawberries makes a very practicable and thought-provoking topic for girls in the seventh or eighth grade.

In the third place the topic under consideration is one of a series centering about the larger topic, "Home Garden," or the broader topic, "Agriculture." In this way it finds its place as a topic in a course and is not an isolated topic by itself.

Out of this topic may grow several lines of activity such as: The examination of soils to determine the best place for a strawberry bed. The various ways in which a soil may be improved as to texture and richness. The planting of a strawberry bed in a school-garden. The care of the same. New plants may be supplied from the school-garden to children who wish to set out beds at home. Pupils may send for the reports gotten out by experiment stations and by the Government as to how to raise strawberries. There will be a comparison of the berries of different varieties as to size, shape, color, quality, hardiness and fertility. The different insect and plant enemies will be looked into and means discovered to get rid of them.

One can easily know when he has finished or gotten away from the subject under consideration, for whatever will help pupils in understanding how to raise and handle strawberries is legitimate work. However, not all the points indicated for study are of equal relative value. One needs to use his judgment in determining relative worth. Further, the work indicated might be the most formal and bookish imaginable, if pupils were not so situated that they could carry out into life the ideas suggested by their study. In other words the human interest might be at a low ebb as far as strawberries were concerned. A country school would be an ideal place for such a topic. In all of our smaller towns and villages this would afford good material for nature-study. In our larger cities much of the work suggested would be inappropriate because there are as a rule no places for strawberry patches. It would be so much formal work tacked on.

GOLD-FISHES IN JAPAN

BY K. MITSUKURI

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[EDITORIAL NOTE—Professor Mitsukuri read before the International Congress of Arts and Sciences, held at the Louisiana Purchase Exposition, St. Louis, Mo., August 21–25, 1904, a paper on "The Cultivation of Marine and Fresh-water Animals in Japan." This paper is now printed in the 1907 Bulletin of the U. S. Bureau of Fisheries. The animals specially mentioned are: snapping turtle, gold-fish, carp, eel, gray mullet, salmon and trout, oyster, pearl oyster, and clams. The cultivation of all these has been developed with great commercial success. The chapter on gold-fish has many points of interest for nature-study in America, because these fishes are so common in aquaria in our schools and homes. Since the original report is not available for wide distribution, we reprint some of the interesting paragraphs concerning gold-fishes.]

The gold-fish is the characteristically oriental domesticated fish. Its beautiful bright coloration and graceful form, with long, flowing fins, appeal most strongly to one's sense of the beautiful. It also is intensely interesting from the scientific standpoint, and proves a source of endless surprises to the biologist, for it is a plastic material with which skillful breeding can, within certain limits, do almost anything. Our gold-fish breeder seems to have understood the principle of "breeding to a point" to perfection, and I have often been interested in hearing some of them talk in a way which reminded me of passages in the "Origin of the Species" or other Darwinian writings. This must be considered remarkable, for these breeders are,

as a general thing, without much education, and have obtained all their knowledge from the practical handling of the fish.

The history of the gold-fish is lost in obscurity. Like so many things in Japan, it seems to be an importation from China. There is a record that about four hundred years ago—that is, about the year 1500—some gold-fish were brought from China to Sakai, a town near Osaka. The breed then brought in is said to be that now known as the "wakin." There must also have been several later importations and the Japanese must have improved vastly on the original forms, as in so many other cases of things introduced from foreign countries. Several varieties have thus resulted, but before proceeding to describe these I may say a few words about gold-fish in general. A characteristic of the gold-fish, no matter of what variety, is that the black pigment with which the body is uniformly colored when first hatched from the egg disappears in a year or so and gives place to bright colors, which are of various shades between carmine and vermilion red and which may be either spread all over the body or variegated with white in various degrees. A fish that is entirely white fetches no price in the market, and is mercilessly eliminated in the first year. A fish with the white body variegated with red around the lips and on the opercula and all the fins is considered to have the best coloration. The dorsal fin is either single or absent. The tail may remain simple, as in ordinary fishes, but should best split open and spread out horizontally, when it is therefore three-lobed, but quite as frequently it may be split in the median lines, when it is four-lobed. The anal fin may also very often split open and become paired.

There are five well-established varieties of the gold-fish in Japan, and in addition one or two which have not become so common as yet. [Here follows a description, with photographs of the varieties].

The gold-fish is very common in Japan, and more or less reared in all parts, but the main centers of cultivation are Tokyo, Osaka, and Koriyama (a small town near Nara, where almost every household engages in this business). Each of these places has its own peculiarities in the method of raising, but the differences are, on the whole, in minor details only. In Tokyo, gold-fish breeders are all located in low-lying parts of the city, where ponds, a sine qua non of this business, can be easily made.

The process of rearing gold-fish is in its main outline as follows: Large gold-fish that are three or four years old, with good forms and healthy in every respect, are carefully selected for the purpose of

breeding. This takes place any time between the last part of March and the middle of June, the usual time being in April and May. At this season the color of the fish becomes more brilliant than ever, and small, low warts that can barely be felt with one's finger are said to be produced on the opercula of the male. Both sexes crowd together, causing great commotion in ponds in which they are kept. Plenty of a waterweed ("kingyomo," or "matsumo," Ceratophyllum demersum Linnæus), or bundles of fine roots of the willow tree are placed in the pond, and on them the gold-fish lay their eggs. It is an interesting fact that gold-fish breeders are able to control, within a certain limit, the time of deposition of eggs. If the fish are given plenty of food beforehand and then the water of the pond in which they are kept is renewed, or if they are placed in another pond, they will deposit eggs in a day or two. On the contrary, if they are underfed and kept in the same stagnant water, they will desist from depositing eggs sometimes altogether.

The eggs take eight to nine days to hatch. The young for the first few days are given the yolk of hen's eggs, boiled. Food is usually given them on shallow earthen-ware plates, slung by three strings from a bamboo pole, for the youngest these plates being kept at the depth of a little over one inch below the surface of the water. For the next two or three weeks the young are given various kinds of fresh-water Copepoda. These the gold-fish greeders prepare beforehand in a separate pond, for they have the knack of producing these water fleas in any quantity they need at any time they like. After Copepoda, succeeds the ordinary food of the gold-fish, such as fresh water, earthworms, boiled cracked wheat, etc. It is essential for the growth and health of the fish that they be kept as warm as possible; hence, the shallow earthenware dishes from which they are fed are kept at first—that is, when the fish are first hatched, and therefore, in the hot season—only a little over an inch below the surface of the water. With the growth of the young and the approach of the colder weather they are gradually put down lower and lower, until in the winter they are down nearly ten inches, such a depth being naturally warmer than nearer the very surface of the water.

Among the young fish all sorts and conditions of the body and the fins are found—that is, all forms intermediate between those closely resembling the normal crucian carp with a long slender body, the unsplit tail and anal fins etc., and those which are extremely modified, as shown in the varietal types described above. If a lot of

young contains a large percentage of those with the unsplit tail, it is considered, from the commercial standpoint, a failure, for these latter are only a fraction of the split-tailed in price. In some experiments I have tried it was found that in selecting for breeding the adults which have the split anal fin give, on the whole, better results than those with a single anal. It is needless to say that all undesirable ones are early eliminated.

All the young just hatched are dark in color, the bright colors coming only later. A great deal of experience and skill is needed in making the gold-fish change its color from black to red. If a person who is not an expert tries his hand at raising a lot of young gold-fish he will find to his sorrow that the fish remain black and do not assume bright colors, while those which may be from the very same lot of eggs, but have been under the care of a professional breeder, may have all donned the beautiful hues. The essential points to be attended to in bringing about the change seem to be (1) that the young fish should be given plenty of food, (2) that they should be exposed to the sun's rays and be kept as warm as possible, and (3) that the water of the pond in which the young are kept should be changed occasionally, although sudden transfer from warm to cold water in the middle of the day is to be avoided. The change of color begins in about sixty to eighty days from the time of hatching, and by the middle of August the fish should all have lost the dark pigment and acquired bright colors. I am told a curious fact that the fish which change their color earliest are apt to be white or variegated white and red, while those that change later are apt to be uniformly red. What can be the significance of such a fact? I am also told that by the middle of August of the second year, all the individuals, however obstinate, change their color. It is worth while determining whether, even if the young are left to themselves and not given the care which they receive at a breeder's, they will change color by the summer of the second year.

White is commercially worthless and is ruthlessly weeded out. It is also said that to improve the brightness of the color, the fish should be somewhat underfed—that is, should be given about 90 per cent of the ordinary feed. In Koriyama they have the trick of bleaching out white spots in the red, by applying some mixture. The result, I think, is not worth much.

I have by no means exhausted the subject of the gold-fish; in fact, I doubt whether anyone can write all the minute details of the art of

gold-fish raising. But I think I have said enough to show how full of interest gold-fish breeding is, not only from the commercial or aesthetic point of view, but from the purely scientific standpoint. A most casual glance shows it to be full of problems which have ever attracted the serious attention of biological investigators.

I have just now no available statistics in regard to the output of gold-fish, but the number produced must be millions upon millions. It shows the power of children in the nation, for they are par excellence the customers of these establishments. It is said that in the old règime, even in years when a famine was stalking in the land and hundreds were dying from starvation, there was a tolerable trade in gold-fish, proving the truth of an old proverb: "Crying children and landlords must not be disputed." Landlords are not now tyrannical as of yore, but children have not abated their power in the slightest degree, and that they do not get the moon seems simply to be due to the fact that it involves an impossible feat for their parents.

DEFINITE PROBLEMS IN NATURE-STUDY

BY S. B. SINCLAIR, Ph.D.

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One of the chief characteristics of the modern disease of neurasthenia or over-fatigue is that the individual becomes morbidly ambitious, sees so many things to do that he does not know which to begin first, and when he does attempt anything is overwhelmed by the idea that he ought to be doing something else.

The student who begins nature-study late in life is likely to find himself in a somewhat similar predicament. With but little time at his disposal he is suddenly faced with an almost infinite variety of interesting topics each demanding immediate attention, and offering unexplored realms of investigation, which at the end of a lifetime of persevering toil would present more unanswered problems than at the beginning. For such an one there is probably no better method to adopt than to select some quite limited area, hitherto unexamined and to confine oneself to a simple and easy problem until it has been mastered. In this way while the general incidental observation of nature goes on as before, a scientific habit of study is being formed which leaves a residuum of knowledge and insight which could never have been obtained by haphazard work. Such problems lie within

easy reach of everyone, problems requiring no special apparatus or guide and capable of affording genuine pleasure to the learner.

The following elementary study is submitted in the hope that it may be suggestive of others and also emphasize the fundamental principle that at the beginning the main difficulty lies in selecting a suitable problem and making a definite and sequential study of the subject chosen.

FOREST DEVELOPMENT

The island of Hunto in Portage Lake twenty miles southeast of Parry Sound, Ontario, has an area of about seven acres and, like other islands of the Muskoka region, is simply the summit of an upheaved mountain of Laurentian granite, the highest point being about 80 feet above the level of the surrounding lake. About two-thirds of the surface is covered with soil varying from one inch to thirty inches in depth.

In the year 1886 the island, which was then beautifully wooded, was swept by a fire which completely destroyed all vegetation except a few straggling pines at the water's edge. Those who saw the island during and after the fire say that the desolation wrought was so complete that it is scarcely possible that any young plants or even seeds could have survived the intense heat. Since that time no new timber has been cut, no domestic animals have been on the island, and with the exception of a few hares, deer-mice, and squirrels, there apparently has been nothing to interfere with the development of the smallest herb.

This situation seemed to present a problem which if worked out might cast some light upon the kind of vegetation which under similar conditions (of climate, soil, non-interference, etc.) might reasonably be expected to develop in a period of eighteen years. In this article I shall confine myself to a statement of the results of investigations made during two consecutive summers regarding the trees and shrubs on the island.

The following is a list of trees and shrubs found August 1904:

Clematis Virginiana—virgin's bower or wild clematis; Rhus typhina—staghorn sumac; Acer saccharinum—sugar maple or hard maple; Acer dasycarpum—silver maple or soft white maple; Acer rubrum—soft red maple or swamp maple; Acer spicatum—mountain maple or shrub maple; Acer Pennsylvanicum—striped maple; Rosa Carolina—swamp rose; Spiraea salicifolia—common meadow sweet; Ribes prostratum—fetid currant or skunk berry; Rubusstrigosus—red raspberry;

Cephalanthus occidentalis—buttonbush ; Loniceraciliata—fly-honeysuckle; Sambucus pubens—red-berried elder; Gaylussacia resinosa—black huckleberry; Vaccinium Pennsylvanicum—low blueberry or blue huckleberry; Vaccinium Canadense—Canada blueberry; Arctostaphylos Uva-ursi—bearberry; Epigæa repens—trailing arbutus or May flower; Gaultheria procumbens—wintergreen; Cassandra calyculata—leather leaf; Ilex verticillata—winterberry or American holly; Nemopanthes Canadensis—mountain holly; Quercus alba—white oak; Quercus macrocarpa—mossy-cup oak; Quercus rubra—red oak or black oak; Myrica gale—sweet gale; Betula papyrifera—paper or canoe birch or white birch; Betula lenta—black or sweet birch; Salix discolor—glaucous willow; Salix humilis—prairie willow; Populus tremuloides—American aspen or poplar; Populus grandidentata—large toothed aspen; Tsuga Canadensis—hemlock spruce; Abies balsamea—balsam fir; Pinus resinosa—red pine; Pinus Strobus—white pine; Larix Americana—American Larch or tamarack; Thuja occidentalis—American arbor-vitæ or white cedar; Juniperus communis—common juniper; Taxus baccata Canadense—ground hemlock; Amelanchier Canadensis—Canadian juneberry or shad bush; Prunus Pennsylvanicum—wild red cherry; Prunus serotina—wild black cherry.

It will be noted that altogether there are less than 50 varieties and a number of these were added in the previous year.

The following is a statement of the height and circumference of a few of the largest trees in 1904 and 1905. The first column gives the height in feet, the second the circumference in inches in 1904; the third and fourth give the corresponding measurements for 1905:

Populus tremuloides, American aspen, poplar	35	12	37	14
Betula papyrifera, paper or canoe-birch	30	16	32	18
Prunus Pennsylvanica, wild red cherry	29.	16	30.5	16
Pinus Strobus, white pine	22	13	23	13
Acer rubrum, soft red maple	22	9	24	13
Quercus rubra, red oak or black oak	20	14	20	16
Thuja occidentalis, American arbor-vitæ or white cedar	20	15	20.6	16
Pinus resinosa, red pine	19	11	19.5	13
Larix Americana, American Larch or Tamarack	16	8	17.5	9.5
Quercus alba, white oak	15	8	16.5	9.5
Abies balsamea, balsam fir	13.5	9	15	9.5
Tsuga Canadensis, hemlock spruce	11	5	11	8

The time and labor requisite for collecting, identifying and mounting specimens and for measuring trees in such an investigation is not great. Nor is the collection of specimens a necessary condition of such investigation. The study of the living organism from the genetic functional standpoint is of much greater value than the mechanical examination of dead specimens. One of the best features of such work is that it presents obstacles which furnish a natural stimulus to

endeavor and which when overcome afford genuine satisfaction. Where serious difficulty is presented and individual observation and text-books prove inadequate, the Canadian Government has wisely made provision for all emergencies by providing trained specialists, who are able and willing to answer questions submitted to them and to whom letters of inquiry can be sent postage free. In this connection my best thanks are due to Dr. Fletcher, of the Experimental Farm, at Ottawa, who not only supervised the classification made, but also made a personal inspection of the locality studied.

The essential requirement of a university post-graduate dissertation is that it must add something no matter how little to the sum total of human knowledge. Measured by this criterion such an investigation as the foregoing be it ever so limited in scope or unpretentious in character at once becomes important, for one finds oneself doing that which has been done by no one else, and if the work be honestly performed and the records accurately kept the information gained (although apparently trivial) may prove to be of genuine public service in future interpretation.

Another of the advantages of such definite research work is that is it adapted to the stage of development reached by the adult learner who although he has omitted nature-study in early life, has acquired as the result of natural growth and activity in other studies a scientific attitude of mind which causes him to appreciate the meaning and value of the laboratory method and to prefer it to a more superficial treatment.

The experience of the Ottawa Normal students in the study of birds affords practical illustration of this fact. For a number of years each student has been asked to learn the identification and general characteristics of sixty species and to make a careful and thorough study of one species as regards life-history, life-relations, care, etc. The invariable opinion expressed by the students is that they find the intensive study more interesting than the more extended observation.

From the standpoint of the learner the actual knowledge gained is of genuine value, being in a very especial sense his own. It is probable however that what may be called the indirect results of such an investigation are really of most worth to the student. The attention is sure to be attracted to a thousand interesting phenomena which otherwise would have passed unnoticed. For example in the foregoing investigation certain kinds of trees were found to be grouped in

favorable places in their own special habitats. There was a preponderance of ferns, fungi, and mosses on the northern exposure where there was least evaporation and swamp plants were found in the lowest parts of the Island. An oak growing in a cleft of the hillside attracted attention by its abnormal contour. It was found on measurement that its height was only 12 feet while the branches had extended laterally until from tip to tip the tree measured 19 ft. 6 in. It was evident that the tree had not been broken in any way. A brief investigation revealed the causes of the extreme width. The tree grew on a shelf of rock facing the south, with another rock rising vertically close behind it to the height of about 12 feet. The reflection of the sun's rays from the posterior rock together with the shelter from the north wind had created a condition of average temperature many degrees warmer than that above the 12 feet limit and the tree branches had by the principle of heliotropism followed in the direction best adapted to development.

Many other interesting phenomena in connection with soil formation, heat and moisture conditions were similarly incidentally noted.

Further, in such study one is sure to become impressed with the fact that the investigation of sequential life-history is more interesting than the study of a cross section. "What have we here?" is seldom as productive a question as "How did it get here?" or "Whither does it tend?"

While carrying on the foregoing investigation such problems as the following naturally suggest themselves: "How were the seeds brought to the island?" "In what order did the trees appear?" "What other trees will come and how will they come?" "Will the struggle for supremacy leave conditions as at present, e. g. will the poplar continue to rule the pine?"

At the beginning most nature problems must of necessity involve little more than an inductive-analytic treatment of individual cases, and the study is best conducted first-hand and without the aid of books; but as the investigation advances and hypotheses are suggested, the emphasis is thrown more and more on the deductive side, and the aid of the specialist and the text-book becomes increasingly valuable.

Professor Chamberlain, head of the geological department in the University of Chicago, used to say that when he went on a field excursion there were always many hypotheses in the foreground of his consciousness each struggling for confirmation. The student who is

only beginning nature-study will find the interest of the work greatly enhanced by the formation of a similar habit of alertness regarding presentations which are likely to throw light upon problems previously met with in experience. For example it has been pretty well established that as a rule in forest growth conifers come in early and for years require shelter which is afforded them by herbaceous trees. It has also been observed that seeds of willows and poplars are light and are blown far by the wind, that the red cherry seed is edible and is carried by birds, that acorns are hoarded by squirrels and mice, and that water washes up many varieties of seeds.

In our investigation we found constant verification of these and other well known theories. A striking illustration of the fact that seeds may be unintentionally disseminated by commerce was afforded by the appearance of dandelions only in places where packing boxes had been opened.

The narrow limits of such a paper will not admit of further reference to the more fascinating and productive studies of structure, function and life-relations. The interest in such work is always cumulative, the nature-study attitude soon becomes habitual and after that all is clear sailing.

A SIMPLE EXPERIMENT ON SPONTANEOUS GENERATION

BY F. L. STEVENS
Professor of Botany and Bacteriology in North Carolina College of Agriculture and Mechanic Arts

One of the greatest controversies of the world, one freighted with results of the utmost importance to mankind, was the controversy over the spontaneous generation of micro-organisms which was at its height in the fifties and sixties of the last century. Decline in the belief of spontaneous generation from earliest ages to that time had been constant. The Aristotelian belief in the generation of eels from the mud of the Nile, and the early grotesque belief in the ability of foliage of certain trees to change into mammals, fishes, and birds had given way under the searching criticism of later observers. Finally even the spontaneous generation of maggots was disproved by the Italian Redi (1629–97), and their origin from eggs laid by flies demonstrated.

With the discovery of micro-organisms—bacteria, yeasts, and the like—the spontaneous generation controversy was reopened. While

man was ready to deny the spontaneous development of mammals, birds, fishes, and even insects, however small, here was a new field for thought, and many scientists of high repute became champions of the belief in spontaneous generation, or development *de novo* without paternal organisms, of these minute creatures. With the poorly developed technique of the time the problem was not an easy one, and with a less skilled experimenter than Pasteur the truth might long have remained hidden. Pasteur's demonstration was however complete, and so far as man yet knows, no organisms, large or small, plant or animal, now live that do not spring into existence from parents of their own kind. There is no evidence that spontaneous generation occurs or ever has occurred.

The spontaneous generation controversy led to the founding of the science of bacteriology, and through it came improved surgical methods and the prevention of contagious diseases. Many household acts and arts, canning, cheese and butter making, preserving, pickling, as well as various medical and surgical practices of the house, are based directly upon the assumption of the non-occurrence of spontaneous generation.

So important is the idea that germs of putrefaction and decay do not arise *de novo* in putrescible liquids and so interesting is the controversy historically that it becomes a fitting and interesting subject for school experiment. The experiments may be conducted in this way: Prepare seven tubes for containing clear beef broth. If you can secure them use ordinary test-tubes (5-inch tubes cost about two cents each). Ordinary bottles though not quite so convenient answer every purpose. Clean the tubes or bottles thoroughly, dry them, and plug each tube with cotton. Then place them in the oven of your kitchen stove, and bake them just long enough to turn the cotton slightly yellow, not long enough to burn it at all. This we call sterilizing the tube. By baking it in this way we kill every living thing that is in the tube, all of the microscopic germs, yeasts, etc., of all kinds. Now prepare your broth to put in these tubes. You may make the broth by allowing some chopped meat covered with water to soak over night, and then squeezing it through a piece of cheese cloth to get the liquid out. Boil this liquid and then pass it through filter paper in order to make it clear. Any druggist will let you have a piece of filter paper and will show you how to use it. When you have gotten the broth clear place a little of it, say two inches deep, in each of your test-tubes. In opening the tubes and pouring the broth in it

is possible that some germs from the air may fall into your broth. You must therefore sterilize the tubes and the broth in them again. It will not do to place them in the oven as you did before because you would dry the broth up, and crack the tubes. You must employ a method of wet sterilization which you can easily do by setting the tubes in a tumbler in a steamer and steaming them for thirty minutes. One steaming is not sufficient, however to kill all the germs. You must steam them thirty minutes today, thirty minutes tomorrow, and thirty minutes the next day. This is called discontinuous sterilization. After the third day the broth is completely sterilized and there is no living thing in it. The broth in all of the tubes should then look just alike.

Now for the experiment. You may set tube No. 1 away without opening it at all. From No. 2 you may take out the stopper, keep it out one minute, then replace it. From No. 3 you may remove the stopper and leave it out thirty minutes. From No. 4 remove the stopper then pick up a little dust on the point of a knife and drop it into the tube, not enough to be visible at all after it is put in, but just a little bit. To No. 5 add dust just as you did in No. 4, and then close the tube and set in a pan of boiling water and leave it there 10 minutes. To No. 6 add dust just as you did in No. 4 and also add a little carbolic acid. To 7 add a drop of ordinary drinking water. Now set the tubes all away together in a moderately warm place, and look at them day by day for a week or two. After a time you will notice that Nos. 3, 4, and 7, and possible No. 2 are becoming cloudy, while No. 1, 5 and 6 do not become cloudy. A few days later this cloudiness increases. Possibly a scum appears upon the surface and very likely a sediment in the bottom of tubes Nos. 3, 4, and 7. If you remove the stoppers from 3, 4 and 7 and shake them you will find that they smell badly. Nos. 2, 5, and 6 do not smell so. In these turbid tubes the broth is really decaying. In the clear tubes it is not. If we should examine the contents of these tubes with the microscope, we would find in the turbid tubes myriads of wiggling, living, squirming germs, bacteria. In the clear tubes there are none of these.

Now let us see what all of this means: It is quite clear that in tube No. 1 we killed all the germs and since we did not open it, no germs could get in. It is equally clear that in tube No. 4 we added some dust and there was a great possibility that germs were present in the dust. Indeed it would have been possible to have found them

there with a microscope. The germs which were planted in No. 4 began to grow and multiply rapidly, increasing from a few thousand to many billions and causing putrefaction of the broth, with its accompanying bad odors as they did so. Tube No. 1 if left unopened would remain sweet and clear for years, while any tube would immediately begin to decay if dust were added. But how did the germs get into tube No. 3? Let us see. This tube was left open thirty minutes. Dust very similar to that put in No. 4 is floating about in the air. It is quite possible that during the thirty minutes some such particles may have fallen into the tube. If we find any indication of germ life in Tube No. 3 it is quite certain that the germs gained entrance from the air. With tube No. 2 the conditions are very similar, except owing to the shortness of the exposure the probability of decay is much less.

To tubes Nos. 5 and 6 we are certain that we added germs with the dust. Why did these tubes not putrefy? It is evident that the boiling to which No. 5 was subjected, and the carbolic acid placed in No. 6, either killed the germs or prevented their growth. The decaying of No. 7 shows that even a drop of drinking water bears with it germs.

The experiment is quite convincing and forces us to the conclusion that when substances are properly sterilized and all germs prevented from entering no putrefaction will result and no germ life appear. If, however, germs be added to these sterile putrescible substances the germs will develop in immense numbers and the liquids will consequently decay. In no case, if the work be carefully done, will the germs appear in the sterile tubes unless they have gained access from the outside. That they can come into existence spontaneously, without parentage, seems impossible after this experiment has been made. Not only has such an experiment been made once but many times with unfailing success, and many important industrial and hygienic practices have been based upon the conclusions afforded by it and lasting benefits of untold value to mankind have resulted.

SUNFLOWERS FOR GOLD-FINCHES

BY DELIA M. HALE

Teacher of Grade IV, Upsala St. School, Worcester, Mass.

In lessons on seed germination the bean has held the place of honor about long enough. After it has fulfilled its mission of swelling and sprouting—not to mention decaying—it is consigned to the waste basket to be thought of no more.

Acting upon the suggestion that a seed be chosen with a view to a future career of usefulness, the sunflower seed was selected. The ink-wells at each desk were lined with cotton kept moist, but not wet. Enough cotton was put in to make a fairly thick layer for both sides and top. In each ink-well were placed three sunflower seeds, and upon them was lavished the greatest care, varying from the tender solicitude of the girls, to the more business-like—though none the less devoted—attention given by the boys. And now there began a supervision by each child that completely disproved the truth of the old adage "The watched pot never boils." As soon as the children reached their desks in the morning they eagerly looked to see what new change had taken place through the night and more eagerly told of the swelling of the seed, or the cracking of the shell, or the already started sprout, they had found. There was no dying out of their interest, because the seeds of all attained different stages of development each day, making it true that "competition is the life of seed germination."

As soon as the seeds had sprouted sufficiently, they were planted in small pots furnished by the children. From the woods they brought rich soil, mixed it with the proper amount of sand, sifted it and sprinkled it lightly into the pots after putting in broken bits of crockery and flowerpots for drainage.

For several days the pots were kept upon the desks, but later were removed to the window-sills where the sun could reach them. On the days in which school was not in session they were placed in the zinc pan of an umbrella-rack. This held water enough to give the plants sufficient moisture, absorbed through the bottom of the pots.

When the seedlings had reached four or five inches in height they were transplanted to the school-garden. The care of the plants did not end when they were placed in the garden, for they needed protection from the sun through the middle of the day. This was furnished by newspapers supported by sticks, which were removed

when the children went home at the close of school in the afternoon, so that the plants might have the night dew.

In due time the sunflowers blossomed; and on returning to school in September, the children saw flocks of gold-finches feasting on the seeds.

SCIENCE STUDY PARALLEL WITH NATURE-STUDY

BY WILLIAM HALLOCK

Professor of Physics in Columbia University

[Abstract of a paper read at the 1904 meeting of the New York State Science Teachers Association. Published in Sec. Ed. Bull. 28, Oct. 1905, by the New York State Education Department.]

The fact that "things in motion sooner catch the eye than that which does not stir" has been the chief argument in favor of an early study of animals in the elementary grades, and these and flowers have monopolized the time and attention of child and teacher. To my mind the chief benefits of nature-study are outdoor exercise, and acquiring the ability to see. If nature-study is to be carried on in the classroom, with only infrequent excursions to field and wood, it becomes a laboratory exercise, and does not differ essentially from similar possible exercises in chemistry or physics or mechanics. A child is amused by an animal largely because it moves, because it acts independently, it does things more or less unexpected. The curiosity is excited as to what it will do next, and in fact much of the study of animals, and much of the information taught concerning them deals with statements as to what the particular bug or beast will do under given conditions. For example, in the special leaflets on the toad considerable interest is worked up for this lowly and phlegmatic neighbor, but how much of the information can be the result of direct observation on the part of the child? One must be favorably situated, both as to time and place, to be able to observe even his fly-catching, which is his peculiarity most likely to interest the child and most readily seen. All the phenomena of spawn, tadpole, little toads, and related matters are practically unavailable in the majority of cases, except in the form of stories by the teacher. Of course it is useful to teach that even the humblest of nature's work is full of interest and worthy of the most careful examination; but let us for a moment compare this exercise with the same time spent with a couple of small magnets, a little compass and some iron filings. Here is all the in-

terest of motion, and motion in things usually considered incapable of independent motion. The bristling of iron filings on a card over a little magnet is an entirely novel observation, and one calculated to excite the keenest interest. The picking up of tacks and small iron objects and the inactivity of brass, copper, silver etc. are readily shown. Even the phenomena of magnetism induced in a piece of soft iron can be made perfectly intelligible to any child, and all of these experiments can be performed in any room at any time of the year, and at less expense than the price of a toad. The magnetic tack-hammer is sure to interest a child; and the behavior of the compass needle, including its north-indicating property, and how it serves to guide the mariner at sea, will serve as texts for stories galore. A small piece of lodestone will help to make real the discovery of this property, and floated on a piece of cork or wood will illustrate the guide which helped the first great discoverers to circumnavigate the globe. Have we not here much evidence of the importance of the humblest observations, when a little piece of brown stone floating on a piece of wood in a vessel of water can direct a Columbus to a new world?

Leaves and twigs and plants are the subject of much deserved attention, and are studied in minutest detail. This is of course all very well when such materials can be obtained. Why not devote some attention to the phenomena of crystallization? The quick evaporization of many simple solutions when spread on glass furnishes figures quite as varied, quite as intrinsically beautiful, quite as instructive and quite as distinctive as any leaf forms, and much more positive and accurate. Even the added interest of color need not be lacking. Those charming little "hopper" crystals formed by the cubic crystallization of a solution of common salt, will interest the child and may be made to point a moral, or adorn a tale. The coördination of these phenomena with the ice figures on the window, and the beautiful crystals of the snow, will serve to occupy to advantage several winter periods. The sources of crystallization are almost endless. The beautiful colors of the rarest flowers can be more than matched for a few cents in the simplest chemical experiments, and is the one less wonderful than the other? Is the hand of nature less apparent in the delicate crystal of most beautiful color and form constructed with the accuracy of the mathematician, than in the petal of the flower? Such parallels could be multiplied almost indefinitely, *sed ex uno disce omnes.*

There is one feature of nature-study on plants and animals which

has often been criticized by ultra sensitive people. I refer of course to the dissection or destruction of the object of study. It will be answered that this is seldom practised in elementary schools with even the lowest forms of animals, and plants do not feel, and hence there is no objection to pulling them to pieces. Still the child must be held in constant check to keep down the natural instinct to see what the insides are like, to see what makes "the wheels go round." Perhaps it offers a good opportunity to teach the child not to inflict pain by pulling animals to pieces, but even so it is pretty difficult to differentiate between his curiosity to see how a fly will walk with only two legs, and the scientific dissection for legitimate purposes. In general, the child is naturally enough inclined to pull things to pieces without any encouragement. On the other hand, the most sensitive can not object to an indefinite amount of pestering of a magnet, or a solution. The above matters are simply those of choice, perhaps, and someone may object that we have at best proved an equal claim for attention. There is however a more serious criticism of the present methods. In the syllabus we find for example a subject given as "the function of the roots." How can this subject be efficiently or rationally treated when the child has little or no knowledge of the simple and fundamental phenomena of solution, much less of capillarity, or surface tension, or osmosis? It is again expected that the functions of the leaf should be intellectually discussed, without a preliminary knowledge of anything about evaporation or combustion, or the subtler effects of sunlight, such as bleaching, discoloration, and chemical change in general. At another time the sap is the subject of the talk and the child is told how and why the sap rises in the tree, when in point of fact nobody knows. Right here is an example of a serious mistake which many teachers make: namely of picking out the plausible or attractive theory of all those which have been suggested to explain some phenomenon, and presenting this to the child as if it were finally established. This, to my mind, is positively bad, and is certainly unnecessary. I have always found that a child is really interested to find something which even the "grown-ups" do not know; they feel encouraged and may even set their little brains at work getting up an explanation of the observation in question. A teacher's usefulness has been seriously impaired the moment he or she poses before the children as knowing it all.

It will be objected that chemistry and physics require apparatus and materials and these cost money. I would guarantee to buy all the

needed materials with half the money spent in a single year on nature-study, and most of these materials would last several years at least. When I see the poor grade teacher coming home Saturday with her arms full of branches and twigs, in fact most any old thing, as a result of a forced trip to a roadside just outside the city limits, I always think what a fine physical experiment could have been arranged with half the time and trouble, and at a cost not exceeding her car-fare.

The one real obstacle to the immediate introduction of this class of work into its proper place in the curriculum is, of course and as usual, the teacher. It will be objected that here is another subject for her to study, another demand on her already overloaded time and energy, and she cannot be expected to know enough chemistry and physics to teach these things properly. These same objections were urged with equal application against the introduction of the present form of nature-study. For the surmounting of these obstacles I would make two suggestions: First, that the teachers in the grades should obtain constant assistance and direction and instruction from the specialist teachers in the high school, or from supervisors, as at present in music, art, etc. The high-school instructor in chemistry and physics should always be available to show the grade teacher how to perform and explain these elementary exercises. Any good high-school teacher would be glad to do this, realizing that thus would the work be done properly and an early foundation be laid on which later work in those sciences could the better be built up. Second, there should be prepared a set of leaflets containing complete and explicit descriptions of the exercises, directions for their performance, the materials needed, as well as a statement of the points to be specially emphasized and the conclusions to be drawn. Such a leaflet would enable any intelligent teacher to carry through the exercises on the magnets quite as satisfactorily as she could the corresponding one on the toad.

I would not for the world use one period for indoor laboratory exercises which could be devoted to a trip to real fields and real woods, to nature's real laboratory. Only do not let us try to get lively interest out of a lot of old dead leaves and sticks, or fool ourselves and cheat the children by roaming over some vacant city block, or through some very artificial park. When animate nature sleeps let us turn with equal zeal and interest to so called "inanimate" nature. Nature in fact is always animate. Let us turn to this phase

of nature in the firm assurance that her treasures there are no less simple, no less fascinating, no less profitable alike to teacher and pupil.

THE SCOPE AND METHOD OF SCIENTIFIC NATURE-STUDY

BY M. A. BIGELOW

Teachers College, Columbia University

[Abstract of a paper read at the 1904 meeting of the New York State Science Teachers Association. Published in Sec. Ed. Bull. 28, Oct. 1905, by the New York State Education Department.]

The subject was discussed under four headings: (1)-what is nature-study and how related to natural science of higher schools; (2) the scope of nature-study; (3) the values and aims of nature-study; (4) is nature-study scientific?

1. The line between nature-study and natural sciences should be on the basis of generalizations and principles which are fundamental in organized science. Nature-study is primarily the simple observational study of common natural objects and processes for the sake of personal acquaintance with the things which appeal to human interest directly and independently of the generalizations of organized science. Natural-science study is the close analytic and synthetic study of natural objects and processes primarily for the sake of knowledge of the general principles which constitute the foundations of modern sciences. (See NATURE-STUDY REVIEW, Vol. 1 pp. 14–18, Jan., 1905).

2. Concerning the scope of nature-study, the proposition was discussed that all elementary-school studies of nature should be nature-studies as defined above. At present some of our high-school work, chiefly biologic, is nature-study; but this is rapidly becoming a duplication of work of the lower school. (See NATURE-STUDY REVIEW, Vol. 1 pp. 77–79, March, 1905.)

3. The educational values of nature-study are similar to those of natural science, and may be grouped under (a) discipline and (b) information, along practical, intellectual, moral and esthetic lines. From these values we lead to the aims: (a) to give general acquaintance with and interest in common objects and processes in nature; (b) to give the first training in accurate observing, and in other simple processes of the scientific method; (c) to give pupils useful knowledge concerning natural objects and processes as they directly affect human

life and interests. (See NATURE-STUDY REVIEW, Vol. 1, pp. 54–57, March, 1905.)

4. Nature-study presented according to principles advocated in the foregoing is in harmony with the methods and rules of science, and deserves to be called *scientific*. But it should stop short of the principles and generalizations characteristic of science.

EDITORIALS

SPECIAL PREPARATION FOR TEACHERS OF NATURE-STUDY

Within two or three months we hope to devote one number of THE REVIEW to the above topic. Principals and directors of science departments in normal schools are requested to send to the Managing Editor's office printed literature or specially prepared manuscript which will correctly represent the special work of training teachers of nature-study and elementary science in their institutions.

BEST NATURE-STUDY BOOKS

Some months ago the Managing Editor sent a circular letter requesting many teachers to name about ten books which they find most useful. More such selected lists are wanted before compiling the letters, and readers are urged to send their own preferred lists of books as soon as possible.

SUMMER SCHOOLS

For the April number we want information concerning special courses for teachers of nature-study to be given in colleges and normal schools next summer.

A CORRECTION

The topic "Physical Nature-Study" on page 183 of Dr. Fairbank's paper in the September, 1905, issue should be placed under sixth grade.

QUESTIONS AND ANSWERS

[Editorial Note. Teachers and others are again urged to send to The Review questions which interest them. Now that the magazine is a monthly we hope to give answers without great delay.]

Sleep of Plants. In answer to the question "Is it known why plants go to sleep," interesting information will be found in chapter 6 of Darwin's "Movements of Plants." Miall, in his "House, Garden, and Field," page 124, answers the question as follows :

"Of what advantage is the trefoil leaf to the clover? Watch the leaves at sundown, and you will see that they fold up when there is no more sunlight to be absorbed, and when radiation of heat to the cold sky is to be feared. The division of the leaf into distinct leaflets facilitates the operation of folding; two of the leaflets droop until they become vertical, one edge being turned towards the ground, and the other towards the sky; then the third leaflet folds over the other two, and forms a ridged roof above them. Instead of broad surfaces, only a single edge, answering to the midrib of the central leaflet, is turned towards the sky, and the radiation of heat is checked in proportion as the radiating surface is diminished.

The Darwins ascertained by experiment the effect of preventing leaves from going to sleep on a clear, cold night. The leaves of a variety of plants were pinned open on sheets of cork, or otherwise forced to remain in the horizontal position. Many were hurt, and some killed, while others, whose movements were not impeded, either escaped, or at least suffered much less. Clover and wood-sorrel leaves, when pinned open, condensed large drops of dew, a proof that they had become chilled, while those which were unconstrained remained perfectly dry.

How are the drooping and erection of the leaflets of clover effected? If we look carefully at the meeting-place of the three leaflets, we shall see a kind of cushion, and just beyond it three short cylindrical stalks. Part of each cylindrical stalk is different in texture from the rest; it is glossy, semi-transparent, and transversely wrinkled. Here is the organ of movement for the leaflet."

American Nature-Study Society. In answer to several inquiries, we have failed to find any reference to any regularly organized national society of representative nature-study workers. It seems probable that the inquirers have seen references to an advertising scheme of a well known publishing house which is selling sets of books to local "clubs" arranged by agents of the publishing company.

References on Buds. In answer to a request for suggestions for study

of buds, a teacher of botany sends the following references to literature, some of which is probably available in every library :

Hampton (Va.) N. S. Leaflet (for teachers) No. 8, "Winter buds," 10 cents; Rhode Island Nature Guard (Kingston, R. I.) Leaflet 29, "Tree Buds;" Bergen's "Foundations of Botany" (Ginn & Co.), Chap. 8; Bailey's "Lessons with Plants" (Macmillan), Pp. 1–77; Cornell University Home Nature-Study Course, No. 19, January, 1902; Cornell Teachers' Leaflets, No. 3, April, '98; Huntington's "Studies of Trees in Winter" (Knight & Millet); Lubbock's "Buds and Stipules" (London: Kegan Paul); Andrews' "Botany all the Year Round" (Am. Book Co.) Chap. 7.

NATURE NOTES

Mistletoe. This interesting parasitic plant is the subject of a paper by Mary M. Brackett in the November *Plant World*. The one true mistletoe of the holiday season is Viscum album and the finest specimens come from the old apple trees of England. The American mistletoe, which grows on deciduous trees from New Jersey to North Carolina and westward to the Mississippi, is also found in the markets, but is not so handsome as the imported species. There are about 500 species of the mistletoe family widely distributed throughout the world, growing in divers climates from sea-level to 6000 fee-, and on many kinds of trees.

Galls and Gall-Makers. No. 43 (October, 1905) of *The Nature Guard*, Kingston, R. I., is a lesson on common galls. An interesting suggestion is that specimens be collected and placed in covered jars until the gall-flies appear in the spring.

The Hair-Eel. Professor Prince, Dominion Commissioner of Fisheries, writes an interesting account of the horse-hair eel in the *Ottawa Naturalist*. The popular story that horse-hairs soaked in water will turn to eels rests upon the fact that the hair-eel (Gordius aquaticus) certainly resembles a horse-hair and that they have sometimes suddenly appeared in pools to which horses have had access. Such unexpected appearance is explained by the discovery that certain flying water-beetles are the hosts in which the undeveloped hair-eels are internal parasites and that they may be dried for months, some authors say years, and still regain their former activity when placed in water. They are widely distributed over the world. The popular opinion is that the bite is dangerous, but the mouth is too small to make this possible.

Spontaneous Origin of Forest Fires. In a recent (Dec. 15) issue

of *Science*, Professor Penhallow, of Montreal, describes a blazing beach seen in Maine last September. He concludes after careful examination that it was due to the spontaneous combustion of gases liberated by decomposing sea-weeds in the sands. A similar explanation has long been given for the "will-o-the-wisp" or "Jack-o'-lantern" seen in marshes. Professor Penhallow suggests that such decomposition of organic matter in forests may account for the origin of many forest fires.

Mosses on North Sides of Trees. A foreign journal calls attention to the evidence indicating that most mosses grow where they get most moisture, hence most frequently on the north sides, near the ground, and on horizontal branches. Sunlight also may influence the growth directly and apart from its effect on evaporation.

Okra. This rather uncommon edible garden plant is the subject of Farmers' Bulletin 232 (free upon application to Dept. of Agriculture). It has no great food value and is used because it imparts to soup a pleasant flavor and mucilaginous consistency. It is a close relative of the cotton, the abutilons and hibiscus.

Forestry. An interesting account of the United States Forest Service, what it is and how it deals with forest problems, is given in Circular No. 36 of the Forest Service. A classified list of available publications and guide to their contents adds greatly to the value of the pamphlet.

Butterfly Destroyers. In the 1905 *Trans. Entomol. Soc., London*, Mr. J. Kershaw records his observations on the elimination of butterflies in China. The chief foes are spiders, flies, ants, bugs, centipedes, lizards and birds. His notes suggest that the greatest elimination is in the egg, larva and pupa stages; and that the adults are collectively comparatively safe from enemies.

Centipedes and Cherries. In a recent book on popular botany the long stem of cherries is cited as an example of protective adaptation. The centipedes have been observed eating cherries on the ground, and it is assumed that the animals could not climb down the slender stem holding the fruit. Do the cherry fruits need special protection and is it true the centipedes climb out on the branches and then retreat when they reach the slender fruit stem? We wonder if this is another case of a lively imagination engaged in the mad quest for adaptations which are supposed to be needed in order to lend charm and poetry and romance to nature-study.

NEWS NOTES

Seeds for School-Gardens. The Cleveland Home Gardening Association, which has sent out over a million packages of seeds in six years, will have a special circular concerning seeds ready in January. Send an addressed and stamped envelope if you are interested.

Tools for School-Gardens. Director Hemenway, of the Hartford (Conn.) School of Horticulture has made arrangements to put on the market at a specially low price a set of garden tools of the style and quality found excellent in the Hartford garden. A special descriptive circular will be sent to those who apply.

Samples of Weed Seeds. The two hundred students—farmers and farmers' sons—attending the short course in seed-testing at the Ontario Agricultural College, Guelph, Canada, are being provided with a collection of samples of weed seed arranged by Mr. Painter, Manual Training master at the Macdonald Consolidated School, and Mr. Jackson of the Biological Department. The seeds are those of the twenty-three weeds described in the Weeds Control Act, 1905. They are sent loose in numbered receptacles punched out of cardboard with a wad-punch, covered with glass and backed by a second sheet of cardboard and galvanized iron. The glass cover can easily be removed, but the seeds can be very well studied by means of a lens through the glass. Each receptacle is of such a size that it may be carried in one's pocket. That side of nature-study which concerns itself with the problem of fighting weeds should get an impetus throughout the province when these farmers go back to their homes. Every lad should be able to identify the seeds of our common noxious weeds and every country school should help to this. This plan of arranging the seeds is heartily recommended. Mr. Painter will supply the collection with lists of names on receipt of thirty-five cents.

Director of Farm Schools. The Board of Estimate and Apportionment in New York City has created the position of Director of Playgrounds and Children's Farm schools, under the Park Department. Mrs. Parsons has been appointed, and this gives official recognition to the work which she has carried on for three years.—*New York Times.*

Farmers' Institute and Nature-Study. The State Farmers' Institute of California and the Section of Nature-Study and Agriculture of the California Teachers' Association, held several joint sessions at the December meeting in the buildings of the University of California. The following papers were read: Dr. A. C True, Director Office of Experiment Stations, United States Department of Agriculture, "Why the friends of Agricultural Progress Believe that Agriculture Should be taught in the Public Schools,"; Dr B M Davis of the Chico Normal School, "School Gardens," Supt. L. D. Harvey, of the Stout Training Schools, Menomonie, Wisconsin, "Experiments in Agricultural Education in this and other Countries, What they should Teach Us,"; John Sweet, of Martinez, "Concerning Some Common Sense Ways of Interesting School Children in Nature Studies Relating to Agriculture, Viticulture and Farm Life."

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DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

CONTENTS

	PAGE
Nature-Study and Manual Training. Illustrated. W. A. BALDWIN	41
The School-Garden at Bowesville, Canada. Illustrated. E. A. HOWES	48
Nature-Study in Its Practical Bearings. JOHN P. STEWART	55
Place of Physiology in Elementary Schools. M. A. BIGELOW	67
Notes on New Books and Pamphlets	73
Nature Notes	75
News Notes	79

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THE NATURE-STUDY REVIEW

CONTENTS OF No. 1, JANUARY, 1905

Nature-Study and Natural Science—A Symposium, H. W. Fairbanks, C. F. Hodge, T. H. Macbride, F. L. Stevens, M. A. Bigelow. Physical Nature-Study, John F. Woodhull. Nature-Study and Elementary Agriculture in Canada, W. H. Muldrew. Some Recent Criticism of Nature-Study, F. M. McMurry and H. E. Armstrong. Agriculture in Southern Schools, C. W. Burkett. School-Gardens at Hartford School of Horticulture, H. D. Hemenway. Ant-Nests for Schools, Adele M. Field. Guide to Periodical Literature, Ada Watterson.

CONTENTS OF No. 2, MARCH, 1905

Educational Values and Aims of Nature-Study, S. Coulter, H. W. Fairbanks, M. A. Bigelow. Principles of Nature-Study, J. M. Coulter. Children's Gardens at Worcester, Mass., Illustrated, Edna R. Thayer. Why Some School-Gardens are Failures, T. R. Croswell. Chemical Tablets for Feeding Plants Growing Without Soil, Illustrated, Edward F. Bigelow. A Nature-Study Lesson with Moulds, F. L. Stevens. Nature-Study in High Schools, M. A. Bigelow. Guide to Periodical Literature, II., Ada Watterson.

CONTENTS OF No. 3, MAY, 1905

Why Many Fail in Teaching Nature-Study, L. A. Haigh. Ready-Made Lessons in Nature-Study, L. C. Miall. Flower Shows in City Schools, Alice R. Northrop. Observation Bee-Hive for the Schoolroom, Anna Botsford Comstock. Window Gardens for the Schoolroom, H. D. Hemenway. A Wild-Flower Garden, Isabella G. Diggings. Making a School Lawn, Margaret T. Brown. Time Required for Nature-Study, S. B. Sinclair. Method of Sherlock Holmes in Nature-Study, E. A. G. Lamborn Original Observations from Elementary Schools. Guide to Periodical Literature, III, Ada Watterson.

CONTENTS OF No. 4, JULY, 1905

Nature-Study versus Agriculture, W. M. Hayes. Nature-Study and Agriculture, Anna Botsford Comstock. Nature-Study and Agriculture, F. L. Stevens. Nature-Study in School of Nova Scotia, A. H. MacKay. Teaching Facts in Nature-Study, John Dearness. Nature-Study and its Relation to English, W. M. Heiney. The Silk-Worm for Nature-Study, Alvin Davison. Protective Colors of Animals. Facts Discovered by Children, T. D. A. Cockerell. Guide to Periodical Literature, IV., Ada Watterson.

CONTENTS OF No. 5, SEPTEMBER, 1905

Relation of Geography to Nature-Study, with Complete Outline of Courses for Eight Grades, H. W. Fairbanks. Value of Knowing Names of Natural Objects, Many Writers. An Educational Bee-Hive, Edward F. Bigelow. Do Birds Eat Butterflies, T. D. A. Cockerell. School-Gardens in Philadelphia. School-Garden Notes, H. D. Hemenway. A Plea for Wild Flowers. An Appeal for the Birds. Nature-Study in New Zealand. Nature Notes.

CONTENTS OF No. 6, NOVEMBER, 1905

The Communal Life of Ants, Illustrated, Adele M. Fielde. Study of Deciduous Trees in Winter, Clarence M. Weed. The Children's School Farm in New York City, Illustrated, Fannie Griscom Parsons. Temperance Physiology Sixty-six Years Ago, M. A. Bigelow. Plants That Hide from Animals, M. A. Bigelow. Facts Discovered by Children, Marion H. Carter. Guide to Periodical Literature, Ada Watterson Yerkes.

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THE
NATURE-STUDY REVIEW

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

VOL. 2 FEBRUARY, 1906 NO. 2

THE RELATION OF NATURE-STUDY TO MANUAL TRAINING

W. A. BALDWIN

Principal State Normal School, Hyannis, Mass.

In connection with the discussion of the above subject several questions arise.

Is there any *natural* relationship existing between nature-study and manual training?

If there is such a relationship should it not be easily proven?

If there appears to be no *natural* relationship, is it desirable to foster one? If, on the other hand, we become fully convinced that such a natural relationship does exist, what effect ought this to have upon the teaching of these subjects in our schools?

The first question may be approached from either of two standpoints. We may approach it from the subject standpoint or from the standpoint of the child. In the first case we would naturally look at once into the schools and see how these subjects are being taught and what those in charge are attempting to accomplish in connection with each. Approaching from the child standpoint we would consider the child not in the artificial atmosphere of the school but under the more natural conditions which obtain in the home. It may be interesting to try both lines of approach, but let us first follow the conventional method and consider the matter from the subject side. Are these subjects being taught as though they were related to each other.

If twenty years ago the special teacher of manual training and the special teacher of nature-study of a city had been asked how their respective subjects were related, each would have smiled and said: "I have never thought of such a relation. Of course every subject

is related to every other and when the children study about woods they are studying both subjects, but we never pay any attention to that."

It is, however, interesting to note the wonderful changes which have come in both of these subjects within just a few years. If we trace these through very briefly it will, I think, help us to see the bearing of these changes upon our subject and how gradually the relationship has become more and more apparent.

Let us first note the more or less distinct stages through which each of these subjects has passed in the lower grades of our public schools. A brief statement of the different stages in the development of the study of nature in the grades may take the following forms :

1. Book work—small botanies cut down from the larger ones such as the teacher or superintendent had studied in college. Illustration : Wood's Botany Readers.

2. Reading lessons from nature-study. Readers describing interesting phenomena not in the environment of the pupils. Illustration : Wright's Natural History Readers.

3. The study of lower forms of life taken up in the order of their development as a basis for future classification.

4. The study of plants (taken to school by the teacher) by dissection, drawing and description.

5. The collection of minerals, plants and animals.

6. Studying plants and animals in their native habitation, field excursions.

7. School-gardens, poultry raising, care of pets.

Is it not interesting to see how each step in the gradual development of this subject has called for more and more of purposive physical activity which is coming to be known as manual training?

Let us now glance at the progressive stages in the development of manual training, taking wood work as a type of manual training. Some stages in the development of this side of manual training may be stated as follows :

1. Wood work—making of a set of models arranged to present progressively more difficult and complex problems in construction. Illustration : Russian System.

2. Models less abstract—some of them being articles which might be taken home for use. Illustration : Sloyd system.

3. A choice being given any useful models with opportunity for original designs. Illustration : Modified Sloyd.

4. Models as such replaced by real things of which there has

appeared a need for the school or for the individual pupil. Illustration : Building a book-case, building a boat.

5. The manual training in some of our schools has gradually come to cover almost every form of physical activity by means of which the mind is developed.

The tendency in every form is to the practical or that which touches the life of the child. When one considers such a modern form of nature-study as gardening, it at once becomes evident that manual training is absolutely necessary. In fact, one at times hesitates to

The garden at Hyannis. "The school-garden furnishes one of the best forms of nature-study for the school."

know whether to classify school gardening under the head of nature-study or manual training.

At Hyannis the Sloyd was displaced by the garden work in the upper grammar grades because the former seemed too formal and abstract for these grades. But the garden work was put in charge of the teacher of biology because an understanding of biology was necessary to the proper teaching of school gardening.

Certain it is that the school-garden furnishes one of the best forms of nature-study for the school that has yet been found and we feel

just as certain that the school-garden is furnishing to our children more on the manual training side than they used to get from the wood work. By this I do not mean that the school-garden is bound to furnish a sufficient variety of manual training nor even that a sufficient amount of experience with wood work and wood working tools would naturally grow out of the garden work. As to the relative amount of such work which will be done, much will depend upon the attendant circumstances and much upon the instructor. Stakes for marking off the beds, measuring rods, a box or closet for garden tools are some of the things which we have needed. This year the class which had garden work last spring and during the autumn is building a sail boat.

We have seen how even in the artificial atmosphere of the school the subjects of nature-study and manual training have come to need each other. And especially as the demand to make the school work less abstract, more practical, and more in touch with the life of the child has been making itself manifest.

Let us now consider the subject from the standpoint of the child as we find him out of school. The boy on the farm wishes to use nature for his own purposes. His knowledge of nature and love for nature come incidentally in connection with this use. He helps to tap the trees, gather the sap and boil it into syrup. He is given a hen and chickens if he will make the coop and care for the chickens. He cannot use nature without doing things. Such doing of things we are coming to recognize as manual training of the best type. Out of such doing of things there comes not only the knowledge of nature and the love for nature, but several other things, viz.: a knowledge of the power of nature ; a respect for nature ; a knowledge of his own power over nature ; a respect for himself who can cope with nature, moulding her to his own use ; respect for other workers, and all of those wonderful character developments which grow out of the best kind of manual training.

Is it not evident that for the boy out of school nature-study and manual training are but different phases of the same activity? They are indissolubly joined together. And has not this been true in the development of the race? "And the Lord God took the man, and put him in the garden of Eden to dress it and to keep it."

It would be interesting to trace the evolution of man from the standpoint of the present subject. It is perhaps impossible to get more than glimpses of this development, but I feel quite sure that a careful study would emphasize what a cursory survey seems to indi-

cate, viz.: that the development of the knowledge of nature and of manual training has been in connection with man's economic needs and their supply. Man must eat to live, and so fishing, hunting and agriculture have been developed and man has come to know the natural products of earth, air and sea.

In other words we are coming to see that the best results in manual training have come to man in connection with the gaining of a livelihood, and that man's understanding of nature and even his love of nature have been developed in connection with his strivings to compel nature for his own uses.

We are slowly learning the lesson that if we would help the child to develop naturally we must consider how he has been developing through the long process of civilization. Left to himself he follows this method.

A good illustration of the natural correlation of nature study and manual training is found in Elbert Hubbard's autobiography where he says:

"I left school at 15 with a fair hold on the three R's and beyond this my education in manual training had been good. I knew all the forest trees, all wild animals thereabouts, every kind of fish, frog, fowl or bird that swam, ran or flew. I knew every kind of grain or vegetable and its comparative value. I knew the different breeds of cattle, horses, sheep and swine. I could teach wild cows to stand while being milked, break horses to saddle or harness; could sow, plow and reap; knew the mysteries of apple-butter, pumpkin pie, pickled beef, smoked side-meat and could make lye at a leach and formulate soft soap. That is to say, I was a bright, strong, active boy who had been brought up to help his father and mother get a living for a large family."

Happy is the child who gets a large share of his nature-study and manual training in helping his father and mother get a living for a large family.

At a recent meeting of a farmer's club I made the following suggestions regarding the study of nature on the farm: The life of the child is made up of *work* and *play*. He gets his development through both. He studies nature in connection with both. Shall we help him? Shall we show by our actions that we are interested and sympathetic even when perchance other things seem more important?

Illustrations: The boy washing dishes discovers air under a tumbler. A tempest threatens the hay and the boy finds a bird's nest.

On the work side we may well help our child to know :

1. *Things which make for health*—Care of his own body (hygiene), care of his own room, care of his own house (as to sewage, water, etc.).

2. *Things which make for successful farming*—Care for ordinary crops, for ordinary stock and poultry, for fruit and fruit-trees.

Including soils, fertilizers, insect enemies, bird friends.

3. *Things which make for a comfortable home*—The girl should know No. 1, a part of No. 2, and much about the physics and chemis-

Ninth grade boys building a house for the primary grades to furnish hygienically.

try of simple cooking, canning fruit, washing, cleaning, preservation of furs, etc., simple arrangement of flowers and plants.

On the play side the child may well know :

1. *Things which make for health and joy in life*—when, where and how to fish and to hunt, how to swim, how to skate, how to boat.

2. *Things which make for a broader outlook and an appreciation of literature and art*—when the ordinary birds come and go, the life-history of the butterfly and moth, the squirrel and woodchuck.

Since starting to write this paper it has occurred to me that practically every bit of this work which was suggested as nature-study

might just as well have been labelled manual training. Prof. Hodge says that "nature-study is learning those things in nature that are best worth knowing, to the end of doing those things that make life most worth the living." And I wish to call attention to the fact that there is good manual training in connection with most of the learning and all of the doing.

We have seen that if we approach the subject from the standpoint of the subjects, they are gradually coming closer and closer together. And now we see that from the standpoint of the child, which is really the only true line of approach and the one to which we must always eventually come, there is but one answer. The child is the center. He grows through his various activities. The child life is a unity. Every activity is related to every other. Whether the activity take the form which we call nature-study or that which we call manual training, it is ever and always the same life which is being quickened. Whenever and wherever the child's life is affected by contact with nature he is to be encouraged in his natural desire to understand, as well as one can at his stage of development understand, the meaning of such natural manifestations.

If such parts of nature are taken up at such times, enough subjects will always be on hand and the interest of the child will always be at white heat. We shall simply be heeding the admonition of Froebel —"Follow the child."

Our course in nature-study may seem to lack system, and will indeed lack the system of the schools, but it will have a much wiser system, the system of nature. The former seems fixed, unvarying, but is transient, and will soon give way to another. The latter seems ever varying and unstable but is as old as the human race.

This latest kind of nature-study seems more natural, more nearly approaching the way in which men have come to know of nature in connection with their daily needs. This kind of nature work is not a subject by itself. It is intimately connected with the whole life of the child. Here manual training is absolutely demanded and must be utilized. This is, I believe, the kind of nature-study and manual training to which we must eventually come in the primary and grammar grades of our schools.

Now I appreciate that many of my readers are not teaching in the country and that much of the work suggested must be done, if done at all, in the home. Let me say then that it is not the purpose of the present article to suggest just what anyone is to do in any particular

place or under any particular circumstances. It is rather to suggest the close relationship existing between these two subjects when they come to the child in a natural way, hoping that the reader may enter into the spirit of this kind of work and make his own application to his own particular problem in his own particular field.

THE SCHOOL-GARDEN AT BOWESVILLE, CANADA

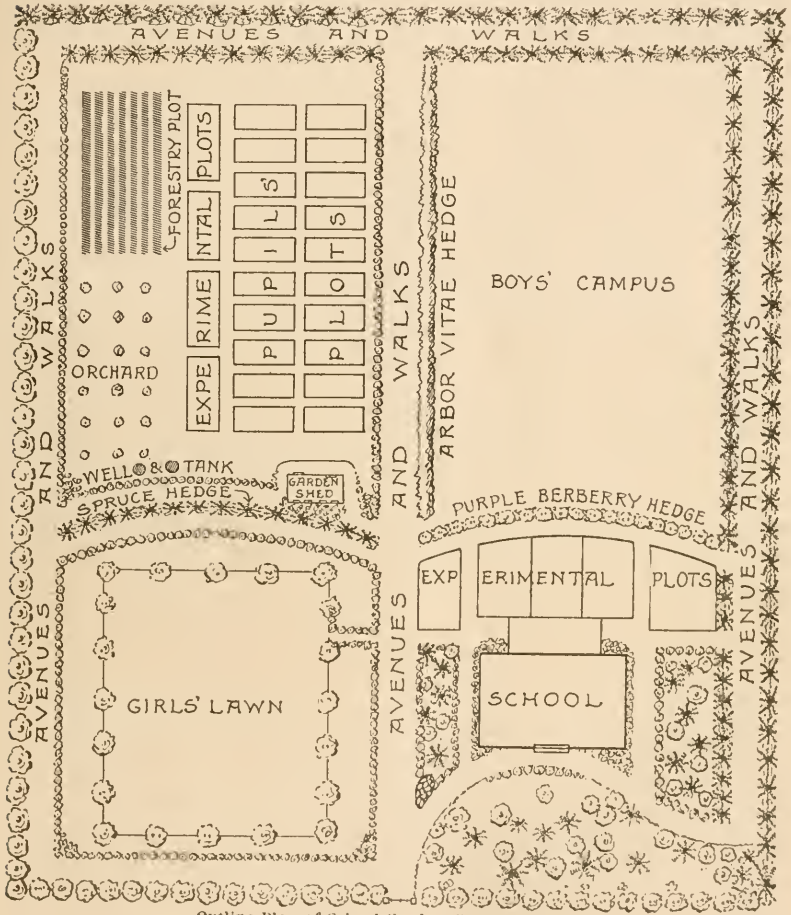
BY E. A. HOWES

In order to give a complete report of this garden we must go back, for its inception, to the generous grant made by Sir William

"The children's out-door laboratory—their school-garden."

Macdonald, of Montreal, to promote school consolidation and the establishment of school-gardens in Eastern Canada. The money was expended for the purpose under the direction of James W. Robertson, then Dominion Commissioner of Agriculture and now devoting to the interests of rural school education that energy and tact which have caused Professor Robertson to be regarded as a personal friend by every Canadian agriculturist. A prospective principal for a proposed consolidated school, and a prospective travelling instructor in nature-study were selected from each of the five eastern provinces and given a series of short courses at Chicago, Cornell, Columbia and Clark Universities and the Ontario Agricultural College. The writer

was fortunate in being added to the class as a sort of insurance factor in the case of withdrawal of any of its members. He was afterwards ordered to return to his old school at Bowesville, establish a school-garden there, and carry on the work for three years, under the auspices of the Macdonald fund, as an object lesson and an experi-



Outline Plan of School Garden, Bowesville, Ont.

ment to determine what might be accomplished along the line of nature-study by means of a school-garden in a large ungraded rural school, under stable conditions, by a trained teacher supposed to be interested in the work. Following is a summary of what has been

accomplished to date, after a two years' experience; and it is hoped that the readers of THE NATURE-STUDY REVIEW will strive to realize the difficult position of one not burdened with too much modesty, writing about his own work, which he is sufficiently enthusiastic to believe is one of the few beginnings in Canada that is to work a revolution in rural communities in the relation of children and parents to their school.

Bowesville, situated six miles south of the Dominion capital, has long been regarded as one of the most progressive sections in the progressive County of Carleton; and it is to the active interest of its people in the welfare of their school that the credit for a large measure of the success of the movement here is due. They have never interfered but to aid. Land sufficient to make a school ground comprising two and one-half acres was purchased, and this was enclosed by a neat fence with turned posts and attractive gates. In laying out the ground many trees, products of past Arbor Days, were retained; but looking to the future young trees from local nurseries were extensively planted, alike for economy and uniform size. Along the north and west fences two rows of the Norway spruce were planted ten feet apart, in order to form a wind-break, and in time an arboreal promenade similar to the one seen at the Ontario Agricultural College at Guelph. Next a row of Austrian pines was planted along the south side of the lot; and two hedges, one of Norway spruce and the other of purple barberry, were utilized to cut the ground into front and rear sections. The front section, the original play-ground, was laid out in grass lawns, with flower borders along the paths, ornamental shrubs and a rockery. This division is already surrounded by large maples, and forms an ideal spot for social gatherings, for it boasts a tennis-court, and is well provided with rustic "seats beneath the shade" for purposes mentioned by one Oliver Goldsmith. The school building is situated in this front section. The rear and larger portion of the grounds has been sub-divided into boys' campus and school-garden proper, by a hedge of native arbor-vitæ. The boys' play-ground has been levelled and grassed, and one portion of it devoted to an out-door basket-ball court. This will suffice for the general plan of the grounds, and we now come to the children's out-door laboratory—their school-garden.

The daily attendance at Bowesville school may be placed at approximately fifty children, ages ranging from six to sixteen. The plan of dual ownership of garden plots has been followed here, a

senior and a junior pupil having joint ownership in a piece of ground (ten feet by twenty feet), working in conjunction and making a just division of the spoils at time of harvest. This plan gets over the difficulty experienced when juniors are shouldered with the entire responsibility of managing a plot, while it does not destroy the sense of ownership which makes proud the juvenile gardener. In laying out and cultivating the garden plots the entire work, with the exception of the ploughing of the ground, was performed by the children; and it may be added, cheerfully performed. Neighboring farmers brought manure for the garden and ploughed the ground. While this was being done the larger pupils made square stakes, and painted them white, for marking off the plot boundaries, the work being done in the children's tool-house. This, a neat ten by twenty structure, is situated at the point where the three hedges meet. It contains benches, a complete set of carpenter tools, also a hoe, a rake and a hand-weeder for each plot, besides spades, spading forks, shovel, lawn-mower, grind-stone, and many other articles useful in garden work. With the aid of a tape-measure and garden lines, twenty-eight plots of the size stated, separated by paths four feet wide, were laid out, staked and levelled. This was all done accurately and furnished a fine means of learning by doing. A certain liberty of choice was allowed in the selection of seeds to be planted, and sufficient of these were furnished the pupils in envelope packets properly labelled. The seeds were bought in bulk and the distribution attended to by older pupils. Then a bright cheery day in early May found the children occupied with their garden seeding. Rows of lettuce, radishes, beets, onions, carrots, turnips, and other staple garden vegetables were sown. One-fourth of each plot was reserved for flower-culture, and in this were sown the seeds of easily grown annuals, such as poppy, candytuft and marigold. Instruction was given by the teacher, ostensibly as a matter of principle, but he claims that the pupil received most benefit by doing his own work. Instead of labels for the rows, the pupils used plans accurately drawn to a scale and prepared previous to seeding.

In this Northland of ours we are not able to put in our seeds and plants at such an early date as may our cousins south of the line, so Bowesville children procured shallow boxes and in early spring started in their schoolrooms asters, phlox, petunias, zinnias, and balsams. As soon as practicable these were transplanted to a cold frame and later on moved to borders and class flower-pots. In the spring of

the first year a hot-bed was used, but owing to spring floods the project was abandoned. Of perennials we have but few yet, a bed of peonies and one of German iris, but we hope to see to this feature of our flower culture next summer. There is a bed of tulips and we have about one hundred and fifty gladioli bulbs. It might be added that during the winter the children grow at their homes quite a quantity of flowers from bulbs, comparing interesting notes on results. What the child grows is his property, but he is responsible throughout the season for the condition of his plot.

The experimental plots, belonging to the senior class, deserve special notice. Experiments in crop rotation, in the effect of clover growth, and in potato spraying have been carried on, and results carefully noted. Bowesville is the center of the largest potato producing section in eastern Canada, so particular attention was paid to potato spraying experiments. In addition to the class experimental plots mentioned, three of the oldest pupils carried on an independent experiment in spraying. Care was taken that the crop received neither more nor less attention, other than the spraying, than did the crop in a neighboring field. Rows of potatoes sprayed with Bordeaux mixture were grown beside rows receiving ordinary attention. When the resulting crops were piled side by side in the tool-house, showing an increase equivalent to more than fifty bushels per acre for the sprayed over the unsprayed crops and also a decided improvement in size and quality, the farmers sat up and did more thinking than would have been the case had they read of the same results in some agricultural publication. It is not so much what these plots teach as it is the trend of thought induced.

Incidentally Bowesville pupils specialize along the line of insect study, particular attention being paid to insects injurious or beneficial to their garden crops. Their interest in this phase of the work does not manifest itself in making collections, although they have many specimens mounted and labelled. Their study of an insect is chiefly from a dynamic standpoint—an attempt to observe exactly what the insect does—and in addition they have worked out complete life-histories of the cecropia, polyphemus and luna moths and of the cabbage and monarch butterflies, having stationary insect cages in the tool-house for this purpose.

The foregoing is a brief summary of the work carried on at Bowesville school; and now, teacher, are you ready with the common stereotyped question, "Where do you, with an already over-crowded

curriculum, get time for all these extras?'' In reply to this it might be well to state that, in the opinion of the writer, the work carried on at Bowesville is too extensive for an ordinary ungraded rural school, unless conditions are very favorable. In this connection I take the liberty of quoting from the new book on nature-study, written by Professor John Dearness, of the London Normal School, ''It is possible to accomplish a good deal with only a couple of square rods of ground and borrowed implements . . . . . Aim to have as fine a garden as the Bowesville one. Failing that, you can surely, if you try, have one at least as good as that described here.'' Very little of the time-table of Bowesville school is marked off for garden work. This is gladly performed during intermissions and in the evenings, and even two or three plots have been maintained by ex-pupils. A little difficulty is met with in plot maintenance during summer holidays, but neglect occurs in isolated instances, few pupils caring to have such a standing monument to their neglect as a weedy plot furnishes. It might be preferable and even necessary to arrange for the services of two or more reliable care-takers, picked from the ranks of the pupils. Let no teacher refrain from beginning a school-garden on account of the idea that he cannot find time for the work, and the labor is one of pleasure. Then when he comes to correlate the garden work with that in drawing, writing, composition, arithmetic, technical agriculture and nature-study, he will be agreeably surprised with the material he has at hand on which he may draw when necessary. Let him begin the work and he will find time to carry it out. The school-garden is not an added burden, but a relief to the so-called burden he now carries.

This garden is one of six in Carleton County, four being under the able supervision of Mr. J. W. Gibson, travelling instructor in nature-study, and one established at Leitrim, near Bowesville, by independent effort on the part of teacher and trustees. Ample evidence of far-reaching results from the work conducted in these gardens is already at hand; but as this is a report of Bowesville garden, we will confine ourselves to results in this locality. In the school itself the good effect on school attendance, on interest in school work, and on the moral tone of the school has far surpassed the expectations of an optimistic teacher. At the homes of the pupils we find many duplicates of the school fence, school flower pots, borders, and ornamental trees and shrubs as evidences of local interest additional to that shown in the experimental work at the school. The erection

during the past summer of a fine modern school-building, pronounced by prominent educationists to be the best of its class in Ontario, may be attributed in a measure to increased local interest in school improvement. As an old gentleman remarked when the project was under consideration, "The school-garden is making a fool of the old school-house." Is this a plea for or against school-gardens? Near the close of last May a union convention of four hundred teachers was held at Ottawa, and these teachers, in bus loads, drove out to Bowesville, and after examining the work there, listened to addresses given by Hon. Sydney B. Fisher, Dominion Minister of Agriculture,

A modern school building, the indirect result of local interest in improvement stimulated by the school-garden.

Professor James W. Robertson, and Dr. C. F. Hodge of Clark University—rather a novel driving party. These are a few of the most striking instances of the effect, seen and hoped for, of the work at this one little centre—a record of visits to the garden would run into hundreds. Time will show what has been carried away.

In conclusion, let me make a direct appeal to school teachers for a trial of the school-garden in connection with their work. Do not attempt too much—be content with small beginnings. If you have a listless pupil, apparently "dead from the ground up," or a refractory pupil, or perhaps a truant, try a garden plot on him. If you are weary of the bone dust you have been handling in the shape of book work, try the effect of this vitalizing factor in your school life. You

will find as much individuality in the different school plots as you do in the different pupils, and find also more scope for manifesting your own individuality. Make the school-ground, the schoolroom and the life of the school more attractive and you will have accomplished something the end of which you will not live to see. "We could never have loved the earth so well if we had had no childhood in it"—happy then is the man whose child life, whose school life, has been brightened by tasteful surroundings and the influences which make for good. If you should come to Ottawa it will give Bowesville people pleasure to have you visit their school-garden, but you must not expect to *see* the best results. These are not on the surface. Endeavor to find such at your own schools.

NATURE-STUDY IN ITS PRACTICAL BEARINGS

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[EDITORIAL NOTE.—The following paper which was prepared for local circulation in Illinois and for that purpose published in *The Normal School Quarterly* contains many suggestions of value far beyond the limits of the State for which it was designed.]

In the preface to his excellent book, "Principles of Agriculture," Bailey says, "A book like this should be used only by persons who know how to observe. The starting point in the teaching of agriculture is nature-study." Again he says, "The purpose of [agricultural] education is often misunderstood by both teachers and farmers. Its purpose is to improve the farmer, not the farm. If the person is aroused, the farm is likely to be awakened ..... If the educated farmer raises no more wheat or cotton than his uneducated neighbor, his education is nevertheless worth the cost, for his mind is open to a thousand influences of which the other knows nothing. One's happiness depends less on bushels of corn than on entertaining thoughts." It is evident that no amount of agricultural precept will reveal to an unobservant man what is going on about him. Our first duty, therefore, plainly lies in teaching how to see, how to reason from what is seen, and to love and appreciate natural things. This is nature-study, and the training it gives is good for living as well as for farming. It is to set forth this relation of nature-study to agriculture and life, and to call attention to the desirability and practicability of ex-

tending its influence throughout our Illinois schools, that this paper is written.

The Bureau of Statistics shows that the value of the principal agricultural crops in the United States during 1903 was $3,200,000,000, while that of all manufactured articles was less than one billion dollars. This indicates that over 75 per cent of our creative livelihood still comes from the farm, from intimate contact with plants and with the soil. Nowadays we hear much of an education for the life that one is to live. Yet the cultivation of intelligence directly necessary to maintain this tremendous industrial activity is dependent upon a few agricultural colleges, experiment station bulletins, and institute instructors, plus the precarious transmission of methods from father to son. That this is far from adequate is shown on every hand. The farmer boy doesn't like to spend the money necessary to take him to college. The bulletins are ineffective because he doesn't understand experimental methods and because he is often unfamiliar with the objects considered, although they may be surrounding him daily. The consequence is that thousands of men go on, daily and yearly repeating mistakes that might easily be corrected if they only knew of the available literature and could really read it.

The failures and losses due to this destructive ignorance are enormous. In our own state, according to Professor Forbes, "the insects alone probably derive as large a profit from the agriculture as do the farmers themselves. They cost us at least half as much as the whole system of public schools, and a very large percentage of this great loss might certainly be prevented, if we could bring the economic facts of this one department into the store of common knowledge at the command of every pupil in town and country school. That we fall far short of this requirement is evident. The Hessian fly is not known at sight in the adult stage or in the main features of its biography to one in hundreds of those who suffer pitifully from its ravages." He might have said the same thing about the codlin-moth, the army-worm, the May-beetle, and several other ravenous insects. It is conservatively estimated that a tenth of all our crops is lost to insects—a yearly loss that would make millionaires of more than three hundred of us per year—not to mention their influence in the conveyance of disease and of unhappiness generally.

On the other hand if we look into the lives of another group of our animal contemporaries and recall the record of Professor Treadwell's young robins, which daily required their own weight of insects to pre-

vent actual starvation, and if we recall the calculations of the Department of Agriculture to the effect that every toad in our garden is worth $19.80 per season, because of the insects, cabbage "worms" and slugs that it eats, we may begin to see the value of discriminating between our friends and foes, of seeking out and encouraging the one, among birds and insects and every living thing, and of discouraging the other. Who will care if the robin does take a few cherries later in the season, when he knows what a powerful ally it has been in protecting the crops against possibly pints of voracious insect larvæ? And yet we still see the small boy out on all possible occasions stoning the toads or practicing with his new gun, and improving his marksmanship at the expense of the downy or the hairy woodpecker that never ate any of his fruit but was giving its strength to ridding his apple trees of the codlin-moth and destructive borers. And his excuse, when he has one, is that it was only an old sapsucker.

But the industrial waste and mistaken effort, which thus directly affect more than half of our earning capacity as a nation, are not our only failings. Few people get the *pleasure* out of life that the allwise Creator designed that they should. We go through too much of life with our ears and eyes closed. Why should Indiana be now publicly urging its boys to remain in the country and shun the city? Why should men be sending off to mid-Africa for plants and shrubs to decorate their homes, wasting their time and money in trying to keep them up in their unnatural surroundings, when nearly every road-side and woodland contains many of our own plants that are fully equal in beauty and vastly better fitted for life here, but are passed by under the name of weeds? Why should many of our invaluable bits of natural scenery be continually torn up and "improved" for financial purposes? Why should it practically require an armed guard to prevent one of our stateliest and most venerable objects of national pride, the giant sequoias in California, from being splintered into pickets for grape arbors? In most cases it is because the actual value of the country and of its common familiar objects is not known. Our education leads away from the woods and fields and waters, the atmosphere of our main occupation, instead of toward them. In Forbes' words again, "One's resources of enjoyment become so narrowed that he is often an object of pity when seen away from a city street. The ordinary tourist in our national park—one of the loveliest spots on earth—rushes from hot springs to geyser and

from geyser to cañon and away again behind six-horse teams, often grumbling then that there is not a locomotive to whisk him about; and if he lingers at all by that lovely wayside, it is only to fish." To how many of us will these words apply? How many of us have uncles or cousins or at least neighbors who go touring in just this way, who went through the Chicago Exposition thus, and repeated the performance at St. Louis, all because they have lost the power of intelligent enjoyment of things beyond their own little spheres?

With these industrial and esthetic conditions of our daily life before us, the question narrows down to how they may best be met. Very evidently this must be through the rising generation. The first course in our chimney must be laid at the bottom. We need a quickening towards nature in the country and among the children, not simply in a few colleges and universities, and among a few nature lovers of the city. We need something that will keep us open-minded and whole-souled; something that will enable us to become more effective citizens because more intelligent in our command of those forces relating to the common things of life. These functions and more we claim for nature-study. It gives the child the means of health; it emancipates him from fear and superstition; it keeps his mind pure by giving it a healthy and natural content; and, as Professor Jackman puts it, "It should lead him to look things squarely in the face, to get at genuine values—neither over nor under—and to be moral from principle."

To accomplish these results we must keep our work balanced. It is very true that there has been too much fad and unattached emotion in what has been called nature-study. But where the subject has been entered into at all and has become anything more than another cram and book study with little or no observation of any sort, it has been beset with a new danger, that of undue emphasis on a single phase, to the detriment of many other equally valuable things. The aim of nature-study is simple enough. Mrs. Comstock puts it, "as primarily to cultivate the child's power of observation and to put him in sympathy with outdoor life." Bailey's chapter in "The Nature-Study Idea," reduced to its lowest terms, defines it as an attempt to relate education directly to the life that the pupil is to live. It is to give him an intelligent sympathy with nature and his environment, to the end that his life may be stronger and more resourceful. Hodge in "Nature Study and Life" defines it as "learning those things in nature that are best worth knowing to the end of doing those things

that make life most worth living.....What things are best worth knowing is indicated by the relations toward nature that the human race has found necessary and valuable to develop." These relations at first are mainly biological, including the mastery of animals and plants.

The keynotes to the first two views are power to see, and sympathy; to the third, the keynote is industrial improvement; and at Columbia University it is apparently the educational value that is uppermost. Each one no doubt recognizes the validity of the claims of the others, and emphasizes the most important phase from his point of view. But from our point of view, it seems that we should be after all these values. They are mutually beneficial—symbiotic, in technical terms—and there is danger of losing the whole coalition if we emphasize one of the symbionts to the exclusion of the others. The man who pins his faith to any single phase will fail to get permanent results. Bringing this to earth, it follows that a boy is not likely even to begin raising chickens, much less to become proficient in it, unless he becomes interested in the life of the chicken, knows something of its relations to comfort and disease, and sees the advantage of putting his ideas into practice.

As to what we should study in nature work, we say the *whole natural* environment within the reach of the child. Everything the Creator has made is worthy of our serious and continued study. That was the idea that controlled Agassiz and that has controlled all his famous pupils to this day. And we have done a great thing if we can impress the child with this fact. He will never be out of something to do. Of course, in the limited time of the class-room, selections must be made bringing out the best that is in the environment: but they should be clearly seen as only selections, and by no means the only objects worthy of our attention. The work should fit the season and locality, have definite trend, and run at least through one year, or through all the grades. We would make the emphasis largely biological in the fall, meteorological and physical in the winter, and geological and agricultural in the spring; the bearing upon the needs of actual life always being considered. The character of the agricultural work has been well presented by President Felmley in the *Normal School Quarterly* for January, 1903. This work should give scientific insight into the fundamental farm processes. We believe with Bailey that it is the fundamentals and principles of farming instead of the incidentals that should get first

attention. We do not care to sew on the buttons before cutting out the garment. We should show the why's and how's of soil tillage, of plant propagation and growth, and of animal husbandry. The school garden makes the proper laboratory for the first two phases, and will be abundantly serviceable if properly used. But without a little of the theory and of the understanding mind back of the raking and planting there is a question as to whether work in the garden should not fall in the athletic department, instead of in the academic.

In biological nature work the fundamental principle is the study of the whole life of the organism. Processes, activities, relations to environment and to man, ready recognition of friends and foes with proper remedial measures, constitute some of the minor objective points. But following out the main principle, we find rich fields that are being neglected in the less complete plans of work.

The whole life of plants means from seed to seed, their winter aspects as well as their summer, and includes the wild as well as the domesticated forms. We do not wish to study plants merely when they are at their best, in the height of summer and of flower. We can't sympathize with things until we know something of their vicissitudes, something of the struggle by which they meet this or that assailant. As Mrs. Comstock says, "To study plants only when in blossom is like speaking to your friends only when they are dressed up." We are likely to miss the most interesting phases anyhow, unless we see the plant through at least one year. The individuality maintained in meeting the various conditions of the year is remarkable. Take the one phase, the winter condition of our woody plants. To many people, buds exist only in the spring, and trees stand through the winter all alike, merely leafless specters. But a closer view shows such difference of buds and twigs, in color, shape, covering and arrangements, as to enable them easily to be separated into genera and in nearly all cases into species. In my own work on willows—one of the bugbears of botany—I was able to make out clearer and surer distinctions between the twenty-three species growing around Ithaca, N. Y., than I have yet found in their summer aspects. The same success is being achieved by Dr. Foxworthy and Dr. Wiegand of Cornell, who are using winter characters in the production of a complete key to our woody plants.

But our work on plants must not end with simple observation. Observation is only the first step in knowing, and it demands supplement by experiment, comparison, generalization and deductive

verification. Experiment should be used freely. The pupil must be stimulated to develop skill and ability in growing and propagating plants and in the art of making them comfortable. That is what it all should lead to anyhow. We need more public benefactors in the Horace Greeley sense,—those who can make two blades of grass grow where only one grew before.

The same principle holds in the study of animals. To study an animal in a single stage for a small part of a single day, is nearly the limit of inadequacy. We know far too little of the wild life around us. We hardly know what animals should, and what should not be exterminated, much less how. We ought to know the whole life stories of our animal contemporaries, wild and domestic, their origin upon the earth when possible, the outlines of their history in it, and especially what they are doing around us now both in winter and summer. It is only the complete picture that will satisfy or that will enable us to cope intelligently with our enemies and we should rest with nothing short of it.

This plan makes us investigators. It organizes our work. It puts the text-book where it belongs—a thing to be used whenever it will further our inquiries, and emphasizes the necessity of getting the living animals where they can be kept under observation. We must form collections. We must make aquaria and terraria, and stock them with living forms, making the occupants as comfortable and putting them as nearly into natural conditions as possible. We should form permanent collections to show the life-histories, samples of work, and the relations to environment of our native forms. It is no easy task to do this. Eternal vigilance is the price of a good collection, as well as of other things. But if properly used its value cannot be over-estimated. A child will read about the transformations of insects and even look at their pictures until he can recite them backwards and forwards, all as a matter of course. But just place a set of forms, from egg to adult, before him and tell him that these things are all the same insect, and note the wonder that spreads over his face, and the animated questions that spring up in the presence of the actual things. Our samples of work in these collections should make clear our friends and foes. We can show insects and their destroyed vegetation, injured wood, grain, fruit, meat, fur, and cloth ; and on the other hand we can show them as friends, scavengers, "cannibals," and slayers of injurious forms. This work need not stop with insects. The earthworm with its cocoon and effect on soil ; reptiles and their

eggs; birds with nests and eggs, to a limited extent; and toads, frogs, and other Amphibia are full of interest and their doings should be known.

The imitation of the natural conditions of animals is important in several ways. One never knows what he is going to discover when he starts out to imitate an animal's surroundings. I suppose I had always known, *e. g.*, that a toad had a warty, granular, and dirty looking back. But of what use such a back could be to him was never clear, until our specimen began to hibernate and to gradually sink away into the sand of a terrarium. When he got down on a level with the surface he stopped, and there was never a better imitation of a sandy surface than that back presented. Our toad could sit there and blink away, seeing without being seen, occasionally pouncing out to catch a last straying insect before taking his winter nap, and altogether presenting about as comfortable and as unexpected an example of protective resemblance as I have ever seen. Many caterpillars, katydids and grass-hoppers can also be made much more valuable for study if mounted to show their protective colorations.

Much effective experimental work can be brought to the aid of the observation here, as well as in plants. We can test the strength and athletic powers of insects; the action of kerosene upon young mosquitoes, the effect of poison in checking insect ravages; or we may try to settle the question as to why the earthworms are so plentiful after a rain, by testing their reactions to light, temperature, and moisture; or the question whether the fish swims with fins or tail, by the use of rubber bands.

Excellent individual investigations may be carried on and reported in short essays on local topics, along the lines suggested in Needham's "Outdoor Studies." Also bulletins showing the investigations of others may be reviewed and reported on from time to time, including such topics as "The relation of mosquitoes to health," "Relation of birds to agriculture," "Structure of the corn kernel," "Corn breeding," and "Maintenance of fertility in soils."

These investigations and reviews are generally eye-openers. It is remarkable what can be learned at our very doorsteps. When a bit of feverfew will reveal ants and aphids and lady-bugs and aphis-lions robbing, killing, fleeing, hiding, protecting, defending, and rewarding each other with all the earnestness of a life and death struggle, it is not necessary to go to the wilds of Africa, or even to the World's Fair, to get something to see and wonder at. Yet just these things

and much more are what did take place summer before last at our doorstep, and probably at thousands of others throughout the country.

Meager as our knowledge of the common wild animals is, the situation is not much improved when we turn to the domestic side. In spite of the intimate daily contact with many of our domesticated animals, how much do we really know about them? How many of us have even a fairly complete and accurate picture of them as they originated and lived in the past? as they live now upon the earth? What native traits and capacities enabled them to succeed in the wild where so many others failed? What attracted man to their aid and use? What objectionable traits have been eliminated? What are their present uses and breeds, over the earth; and how have they been produced? How should they be fed and cared for? How many of us know the majority of these things concerning even one domestic animal? Yet this is only a part of what Professor Forbes believes the study of our domestic animals should bring out. If this plan is applied to the horse, ox, sheep, cat, dog, pig, chicken, and turkey, it is evident that abundant work of a kind very near home will be provided. To illustrate its workings we present a brief outlined study of our most important domestic animal, the ox. This study is a modification of some work done under Forbes and Davenport at the University of Illinois, and the sources used were the works of Schmeil, Darwin, Geikie, and Lydekker, together with stock records. This is an excellent, practical field for investigation and essay work by some of the older pupils for report to the class.

The Story of the Ox

Far back in the past before there were any people; before the ice-sheets had swept down from the North; while mastodons, colossal ruminants, fierce carnivora, and troops of rhinoceroses and elephants held sway; when it would have been really dangerous to try to live; in those times which geologists call the Pliocene period, there appeared in Europe a huge, massive, light-colored wild ox. It appears to have sprung from a race of large antelopes, and it was apparent from the first that it was going to make no mean race in the struggle for life. With its keen sense of sight, smell and hearing, the dimmed traces of which remain today in the elongated, horizontal pupils of eyes once bright and beady, in the large, moist nostrils, and in the trumpet-shaped movable ears, it was not easily surprised. When once at bay it plied its sharp horns, often fifty inches in span, with a powerful neck

and massive strength not soon to be forgotten. Its divided stomach and rough, muscular tongue unimpeded by upper teeth in front, enabled it to sweep in its food with great rapidity and then rush back from the open places to chew it in hiding and at rest, thus saving exposure, energy, and amount of food required to live.

But this met only its animal assailants. Those more insistent dangers of the cold, the storm, the treacherous swamp and miry salt-lick and stream were upon it. It met the cold with a heavy coat of hair, the storm with a leathery skin, and the mire with a cloven hoof—a most ingenious device – the two toes spreading apart when entering the mud and closing again when lifted, avoided the suction so dangerous to the piston-like hoof of the horse.

By the time man appeared upon the earth our ox had grown great in numbers as well as in individuals. Man found him roaming the forests and plains from Britain to Greece in great wild droves, and immediately gave chase. The flint hatchets and pierced skulls of the peat-bogs tell the story. These prehistoric hunters were after meat. To them this Aurochs or Urus, as it was called, was a manufacturer, a transformer of materials intrinsically worthless—grass, weeds, twigs, and leaves—into most excellent food and clothing for man. And this has been our attitude ever since. This brought man to the ox, first as an enemy, then, to prevent extermination, as a friend. This it is that makes the ox our most important domestic animal, and the one probably last to be given up, as the competition for the world's supply of plant food increases.

How the ox has changed under man's hand, how it has broken up into breeds so distinct as to appear of different origins, how its uses have been increased and differentiated in the various parts of the world, are matters of record. In answer to the first we will note only the securing of quicker development, the reduction and even removal of horns, as in the Polled Durhams and others, and the extension and increase of the milk flow—110 pounds per day being the record.

Its present uses upon the earth vary from the utter indifference of the Chinese to the almost complete bondage of the many Swiss and Dutch families who depend on their cow for nearly everything. Between these extremes there are all intermediate grades. It is still a game animal in parts of Asia and Africa; a pack animal among the Filipinos; a traction animal with the Hunga-

rians ; a milk producer on a small scale among the Italians, where a single cow and calf constitute a street dairy ; an object of worship among the people of India ; a milk and cheese producer among the Dutch and Swiss, giving us our breeds of Holstein-Friesian and Brown Swiss cattle ; and finally a beef-animal to the Anglo-Saxon (who also cares somewhat for milk), giving us our Shorthorns, Herefords, Anguses, Galloways and others. But our packing houses do not stop here. Even the hair, horns, bones, and hoofs are put to service. The hair is made into felt boots and mattresses; the horns into combs, buttons, knife handles and ornaments ; and the bones into knife handles and fertilizers.

The method of properly caring for cattle, the uses and mixing of balanced rations, the bases for judging dairy and beef cattle, and the status of "residual milking" carry us beyond the limits of this paper, and can be better obtained from agricultural bulletins. But if enough has been given to show the availability of our domestic animals merely as an animal study, and especially if this indicates a way to get the country boy to take more pride in his work, to get a better understanding of it and consequently to become a more effective worker in the world, our efforts will have been abundantly repaid.

We have now discussed why nature should be studied ; we have shown its relation to agricultural teaching, something of what it should include, something of the principles that should guide us in its organization and presentation ; and it remains for us to consider *where* it should be taught. Industrially speaking this last question is self-answering. The all-important place for nature-study is in the country school ; and the farmers are beginning to find it out. But why those schools are not yet doing their full duty is due to two facts. The teachers are not yet awake to the importance of the movement ; and when they do awake they are already so crowded with recitations that they can't determine either what to do or how to do it. The first part of our problem then is to reach the teacher, and since he is so often the product of his own school this is not easy to do. We have to reach the rising generation through one that is nearly always an immediate offshoot of that generation. The opening of the country schools to the elements of natural science has been a problem in our state ever since the founding of this Normal

School. It was because of it that the science requirement was added to teachers' certificates in 1872, but a year later was repealed from the second grade, thus defeating its purpose. Its solution demands continual pegging away at the doors of our country schools; and the vast increase in our nature literature, papers like *Country Life in America*, paid lecturers on agricultural education, and the national movement nature-ward, all point to the speedy opening of those doors.

The second part of the problem—what to do in these schools, and how, is dependent upon knowledge. The teachers hesitate to take up a new study, and we are ready to admit that to bring out the real possibilities of the subject is no holiday task. Like other things of value it is not going to come without some work. But if the facts were really known, of how much can be done with jars and aquaria, simple insect cages, tin cans, window boxes and a garden strip; with the aid of a few good books like those of Comstock, Hodge, Bailey, King, Hemenway, Keeler, and Chapman; and without a single set lesson in school hours, by merely turning loose the instinctive love of collecting and of doing, on the part of the pupils; if the teachers could see how the nature-study spirit is able to change the whole attitude of the school and teacher from that of "impossible cram and mental pretense" to relations of mutual helpfulness, where all are learners together, and it is no disgrace to say, "I don't know," where questions continually arise that "all the wise men cannot answer;" if these things, I say, were widely known, the hesitation would vanish. There is no need of adding a new recitation to the school. In my opinion nothing will kill the movement so quickly as the cut and dried lesson; and it's a sin to try to crowd any more recitations into the country school program. But if the work is taken up in this informal way, at any rate in the beginning, and the beneficent influences of nature and quickened observation are permitted to spread out over the proverbial three R's, over the geography, and composition and literature, we believe that there will never be a return to the old conditions.

THE PLACE OF PHYSIOLOGY IN THE CURRICULUM OF THE ELEMENTARY SCHOOL

BY MAURICE A. BIGELOW

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In considering the relation of "physiology" to the curriculum of the elementary school it is most convenient to center the whole discussion around an examination of the current text-books; for unlike all other phases of nature or science teaching, "physiology" for public schools is characteristically a "book study."

It is a well known fact that, in conformity with laws requiring "temperance instruction," "human physiology" is commonly included in several successive years of the elementary-school curriculum — in some states the subject must be taught in at least six years, beginning as "hygiene" in the primary grades. This arrangement of "physiology" in the elementary curriculum has naturally created a demand for "graded" text-books; and several publishers issue series of "physiologies" which are supposed to be adapted to the pupils of varying stages of advancement. Some of these series consist of four books, respectively for primary, intermediate, upper grammar and high school; and in one case an additional fifth book contains oral lessons which teachers are supposed to give to pupils who are too young for reading the primary book on hygiene.

An examination of the contents of these books raises doubt regarding the desirability of a "graded" series of "physiologies." The primary book is merely a primer of hygiene. Anatomy and physiology are introduced in the "intermediate" volume, and it is attempted to present the general principles of these sciences. The third and fourth volumes deal with anatomy, physiology, and hygiene. Each successive book in such a series is more advanced largely because it is a more detailed and more technical presentation of the anatomical, physiological and hygienic facts; but as regards the important general principles which pupils may be expected to appreciate and retain in memory, the differences between the presentations in the three books for intermediate, upper grammar and high school are so unessential and the resemblances so great that the reiteration must be wearisome to bright pupils.

In this connection it is interesting to note that other subjects of the elementary curriculum, for example, geography, history, literature,

arithmetic, are easily capable of gradation, especially by the sub-division of the subject-matter. A special period of the history of one nation, the geography of a certain state or continent, the writings of certain authors, particular arithmetical manipulations—these suggest the ease of differentiating and grading the common subjects.

Such sub-division is not possible in physiology. All the functions are so bound together in interdependence that no logical grading can be made by studying digestion in one year, circulation in another, and so forth. This method of grading "physiology" by dividing it into as many topics as there are years is in use in some schools, but such a method is unfortunate because it must fail to teach the mutual relationship of organs in the body as a working whole, and consequently physiological facts are bound to stand more or less unrelated in the minds of the pupils. I fail to find that any prominent teachers of physiology or any specialist in the science has approved such sub-division of the science.

Likewise in teaching any one of these functions it is not possible to make gradation of the facts which are important in general education. For example, it is taught as a simple fact in intermediate grades that the stomach secretes gastric juice which prepares proteid foods for absorption. In the next book for upper grammar grades the information that certain constituents, pepsin, etc., of gastric juice are concerned in the digestion of proteids is added. Finally in the high school some supplementary details regarding the chemical conditions and changes are given. It is evident to experienced teachers of physiology that the elementary statement in the intermediate grade and a single laboratory demonstration give the knowledge of proteid digestion which is most important in general elementary education; and the additional facts are details of little value and interest to the pupils below college.

Parallel illustrations might be drawn from the study of any other function, and it could be made just as clear that so far as the essential principles of physiological activity are concerned the subject-matter does not admit of satisfactory grading in a series of books. A large amount of unnecessary repetition of the essential facts is unavoidable, for the important points which pupils will remember are commonly presented as clearly in the "elementary" as in the "high-school" text-book of "physiology."

Such repetition is especially likely to be wearisome when physiology is presented by teachers who are not specially trained for the work.

No doubt that in the hands of a thoroughly trained teacher this subject might be repeated for several successive years and the interest of the pupils still kept at high tension. However, the facts are that investigations of the present teaching indicate that very few teachers possess the special training which will enable them to develop the work from year to year so as to avoid the appearance of almost complete repetition of the really important facts which pupils readily remember.

It may be urged that this repetition has value in impressing the facts upon the pupils. In fact the original reason for the requirement of physiology in a series of years was for the purposes of emphasizing "temperance instruction" by constant repetition. But we question whether the great important facts and principles of elementary "physiology" need repetition in successive years if intensively taught in one year.

The above must be taken not as a sweeping criticism of all separate books in series of "physiologies," but primarily as a protest against the system which makes gradation of the subject in a series of books necessary. Many of the books considered apart from the series to which they belong are excellent in contents, and would be useful for the school ages to which they are adapted, provided that they were not preceded or followed by other books, covering similar ground with identical methods.

It appears, then, that a careful examination of the subject-matter of "physiology" indicates the undesirability of the attempted gradation and repetition of the subject in several years of the school curriculum. Accepting such a conclusion, we may make our criticisms constructive by stating that the teaching of "physiology" should be limited to fewer years of the elementary-school course and made more intensive.

Accepting tentatively the proposition that "physiology" be limited to fewer grades, suggestions regarding such limitations, and also concerning the consequent rearrangement of the subject-matter, may be considered in this connection. Such suggestions are, however, given chiefly for the purpose of directing attention to the problems concerning the present teaching of "physiology." So long as the laws in many States place decided limitations upon freedom in science teaching, suggestions for radical changes cannot be put into application; but they may point the way to improvement in the future. Many of the following suggestions could not be generally accepted for practise in public schools at the present time; but it seems that they indi-

cate the general lines along which advances in the teaching of "physiology" in the elementary school must ultimately come.

With regard to the recommendation above that "physiology" should be limited to fewer years in order to avoid wearisome and useless repetitions and to gain in intensity, I am of the opinion that aside from some general rules of hygiene, the principles of "physiology" (including anatomy, physiology, and hygiene) should not be attempted before the last year of grammar school.[1] At that grade an intensive course of sixty to one hundred lessons of carefully selected material would be vastly more valuable than the whole work now extended over from three to six years in the elementary school with from thirty to eighty lessons each year.

It was the opinion of the scientific advisers of the Committee of Ten of the National Educational Association (Proceedings N. E. A., 1893, p. 159), "that instruction in anatomy, and physiology proper is likely to lead, in some instances at least, to morbid if not prurient curiosity that is productive of far more evil than the instruction is likely to counterbalance for good." In addition to this possible objection, a stronger argument is that there seems to be no reason why children in the first six or seven years should be instructed concerning internal organs. They are too young to appreciate the knowledge they acquire, and are likely to get very erroneous ideas which will be even worse than no knowledge at all. Moreover, the facts of internal structure and "physiology" which are now presented in the intermediate grades are certainly of no practical value to the child. For these reasons it is better to defer the teaching of these topics until the last year of the grammar school; I should even name the first year of the high school, were it not for the fact that so many pupils do not go beyond the grammar schools, and therefore would never have the benefit of instruction concerning the human body. For this reason human "physiology" should be taught in the last year of the grammar school, in which grade the age and advancement of the pupils make it possible to present for the first time, the essentials of anatomy, physiology, and hygiene which are of practical value in the every-day life of the average citizen.

With regard to the study of the human body below the last year of

[1] Possibly local conditions may sometimes make it desirable that "physiology" should be taught in the seventh instead of the eighth grade. This may be accepted as a temporary compromise, but the discussion which follows will indicate the desirability of placing the subject as late as possible in the elementary school.

the elementary school, hygienic instruction is certainly the most important ; and this in the opinion of leading physiologists is the proper work for the earlier years. As has been indicated above, there is no justification for any direct study of the structure and workings of internal organs in the lower grades. Some simple hygienic facts may suggest internal organs concerning which there is much common knowledge. Thus the hygiene regarding posture and breathing may require the mention of lungs, but attempts at anatomical and physiological considerations of these organs would better be left for later years of the grammar school. It is useless to attempt to explain the physiological basis of all hygienic and sanitary rules with which children should be familiar. Much better is the recommendation of the Committee of Ten that "such instruction should be given and received (as many other things concerning conduct must be received by young children) upon authority, than as an appeal to the judgment of the pupil as based on his physiological knowledge."

I doubt whether lessons in hygiene should constitute a separate branch of instruction with a special time assignment on the program in any grade. It seems better to include and correlate such instruction with nature-study and "elementary science," because a continuous series of rules for personal health is extremely uninteresting, no matter how well presented. Certainly there is no adequate justification for repeating lessons in hygiene throughout the intermediate and upper grades ; and if they must be presented as a distinct subject, let them be limited to one or at most two years.

The following, taken from various works on nature-study, will suggest some of the possible correlations between nature-study and hygiene ; but the details of the plan will necessarily depend upon the course in nature-study. In nature-study work with squirrels, rabbits, or other common animals, the form and uses of mouth, jaws and teeth may be made to lead to comparison with human teeth, their use and their care. In other words, all the elementary hygiene of the mouth-cavity may be correlated with nature-studies of animals. Likewise, the hygiene of human skin, hair and nails may be brought up in connection with studies of their structures in various animals involved in the nature-studies. The hygiene of clothing is naturally referred to in connection with nature-study lessons on the fur or wool of animals ; possibly with silk and cotton ; and also with lessons on heat in the physical nature-study. The useful hygiene of the eyes and ears may be introduced in connection with simple experiments

with light and sound. The question of food which is so prominent in elementary books of hygiene, may be associated with lessons in domestic science, and also with nature-study lessons on animals and plants which are used for human food. These are simply suggestions of possible correlations which would involve hygienic teaching in nature-study and elementary science work now in the schools. Such correlations would undoubtedly make the hygiene vastly more interesting to pupils, while at the same time avoiding a separate time assignment. It is doubtful whether there is any hygiene useful for pupils in any of the first six or seven grades of the elementary school which it is not possible to bring into close relation with biological and physical nature-study.

One caution may be necessary, namely, that hygiene should not be dragged into nature-study to such an extent as to make it as wearisome as the present elementary "physiology." This may result from too frequent repetitions of essentially the same correlations.

Summarizing the foregoing discussions, it is recommended as follows: (1) in the lower grades lessons in hygiene should be correlated as closely as possible with lessons in nature-study and domestic science; (2) anatomical and physiological study of internal organs should not be undertaken before the last year (possibly in certain cases next to last) of the elementary school, at which time a year's course of two or three 30-minute lessons weekly should deal with the essential principles of structure and functions of the human body.

In a later contribution to this magazine the writer will describe an eighth-grade course which involves the above suggestions. It is almost unnecessary to say that such a course must be in a private school, for at present public schools must teach "physiology" according to the demands of the special laws which are radically opposed to the ideas of the leading teachers of science in American schools and colleges. However, it is high time that we begin to make some progress with the "physiology" problem, and surely this does not mean quiet acceptance of present conditions as final for the future. On the contrary, we may be making some progress by studying the experiences of schools free from intolerable laws, and from them plan for the time when science teachers in our public schools will be free to choose the place of "physiology" in the curriculum and select and arrange its subject-matter according to the advice and experience of the best scientific educators.

NOTES ON NEW BOOKS AND PAMPHLETS

Sea-Shore Life. By A. G. Mayer. New York: Barnes. 1906. Pp. 181, figs. 119.

This book, the first of a series planned by the New York Aquarium, attempts to present in clear, untechnical language, a description, accompanied by photographs, of the larger and more conspicuous marine invertebrates of the coast of New York State. In order to increase the general usefulness of the work, however, accounts of the habits of a few animals from other regions are introduced. Its aim is to increase intelligent interest in the habits and life-histories of our marine animals, and to disseminate a knowledge of their appearance and relationships. It is not a text-book of systematic zoology. It is designed to be of use to the beginner, and with the hope that a perusal of its pages may stimulate to further study, many references to works in the English language of a more thorough and pretentious character are given. It is also intended to serve as a guide to the collections of the Aquarium, and of the natural history museums of New York and Brooklyn. The book is valuable for the general reader, especially, as a companion for summer trips to the sea-shore.

Hints and Helps for Young Gardeners. By H. D. Hemenway. Hartford, Conn., Pub. by Author. 1906. Pp. 59, ill., 35 cents each; $20 per hundred.

This little book by the author of "How to Make School Gardens" is designed to furnish a low priced guide. "It is intended not only for youthful gardeners, but also for those young in experience." Chapters are devoted to planning gardens, soil tillage, testing seeds, planting seeds, setting trees, making hotbeds, strawberry culture, asparagus culture, window gardening. On all these topics the booklet is a very practical guide and it answers nine tenths of the questions asked by young and old beginners in gardening.

Animal Snapshots. By S. A. Lottridge. New York: Holt. Pp. 339, ill. $1.75.

The great hunters of today use cameras instead of firearms, and better in many ways than dead and mangled animals as proof of the hunter's cunning are the indisputable records on photographic plates. We therefore welcome another addition to the already long list of books which advocate the camera in place of the modern rapid fire slaughtering machines.

The book in hand contains a series of simple readable narratives concerning very common birds and small animals which the author modestly says he

has "come to know a little about" from his own observations. A large number of half-tones from excellent photographs by the author illustrate the book so well that certainly they will help "extend living interest in the animals about us."

Our Big Game. By. D. W. Huntington. New York: Scribner. 1904. Pp. 347, 16 photographic illustrations. $2.

In this book the author of "Our Feathered Game" gives us the most interesting natural history of the large game animals of North America. The following table of contents will show prospective readers what to expect: Book I, the deer family—elk, moose, deer, caribou; Book II, the ox family—bison, musk-ox, mountain sheep, mountain goat, antelope; Book III, the bear family—the grizzly, polar, black and brown; Book IV, the cat family—cougar or mountain lion, lynx.

We are so accustomed to hear that the game animals are almost gone that it is encouraging to read that "the tremendous slaughter and waste have been stayed" and that "the moose in Maine and deer in several New England States are more abundant today than they were when the writer began to shoot." But better still: "The sportsmen of today think more of the pleasures of going out of doors, of picturesque camps beside trout streams and forest lakes, than of the killing of large numbers of game animals. One proof of this is the use of the camera, which today is a part of the standard equipment of the hunter's camp; sportsmen have ceased to delight in being photographed as butchers in an abattoir surrounded by heaps of slaughtered animals."

The book throughout is interesting reading and will certainly greatly increase interest in the natural history and proper protection of our large game mammals.

Outlines of Nature Studies. By W. Lochhead. Toronto: Ontario Dept. of Agriculture. 1905.

These outlines for teachers constitute Bulletin 142 of Ontario Agricultural College. The more than seventy topics cover a wide range of plant and animal life, elementary agriculture, and physical nature-study. In a few places the outlines run far into the field of the science of botany e. g., "Give a botanical definition of a nut" (p. 17); and technical botanical names—pericarp, dehiscent, mesocarp, halophyte—are often used unnecessarily (from the nature-study point of view), because any standard book of botany will explain all such points to those who care to go so far. However, such departures from the real nature-study are uncommon and as a whole the pamphlet ought to help many teachers in acquiring the kind of knowledge which even beginners in nature-study teaching need. It should be explained

that the outlines simply suggest questions, experiments and lines of study; and various reference books are supposed to give the supplementary information needed.

Departments of Agriculture Publications. Of interest in connection with nature-study and elementary agriculture are the following recent bulletins: "Grouse and Wild Turkeys" (Bull. 24, Biol. Survey, 10c.); "Horned Larks" (Bull. 23, Biol. Survey, 5c.); "Guinea Fowl" (Farmers' Bull. 234, free); "Incubators" (Farmers' Bull. 236, free); "Bobwhite and other Quails" (Bull. 21, Biol. Survey, 5c.); "School Gardens" (Bull. 60. Exp. Stations, 10c.); "Game Laws for 1905" (Farmers' Bull. 230, free); "Maple Sugar Industry" (Bull. 59, Bureau Forestry, 5c.); "The Boll Weavil" (Bull. 51, Entomology, 15c.); "Annual Loss by Insects" (Ext. 360, 1904 Yearbook, free); "Game Protection and the Farmer" (Ext, 364, free).

NATURE NOTES

Defenses of Cock-spur Thorn. In a note in the November issue of this magazine doubt was expressed concerning the view that the thorns are primarily developed for protection. In the December *Plant World* Dr. W. N. Clute, editor of *The American Botanist*, writes as follows:

"If you will go into the nearest pasture set with hawthorn, you may have abundant evidence to show that cows do not refrain from eating the hawthorns, thorns or no thorns. Quite on the contrary, they apparently consider them good forage, for every starveling shrub is kept sheared of its tender twigs throughout the summer. The only way in which the shrub can outwit its enemy is to continue to put out side shoots from year to year, letting the cows nip the young and tender tips but making what is left stout and woody until it has formed a bush so wide that no cow can reach the center from any side. Then the shoots in the center may carry the shrub upward, and this they immediately do. Every thorny pasture is full of these bushy shrublets biding their time.

After the shrub has got beyond the stage where the cows can no longer keep its leaders down, the cows continue regularly to trim up the side branches. We are, I believe, to look for the cause of thorns in these plants to some inherent quality of the plants themselves. There are certain families of plants that run to thorniness and several of these are centered around the rose family. There are many thorny species among the legumes and in the rose family, to which the hawthorn is most closely related, e. g., black-

berries, raspberries, roses and others. It seems to me the reason why these plants produce thorns and prickles is because "it is their nature to."

Naming Forest Trees in Streets and Parks. The increased interest in forests and forest trees has, among other things, led many city and town officials to seek to make known the names of trees growing in streets and parks. Not only are such trees in very many cases now without marks of identification, but in not a few cases they have been labeled with incorrect names. The Forest Service of the U. S. Dept. of Agriculture has devised plans by which its co-operation may be secured in correctly identifying the public trees of any community which may care to call upon it.

Cattle Ticks. The Bureau of Animal Industry, United States Department of Agriculture, will soon issue a publication on the cattle disease known as Texas fever, which was shown several years ago to be due to a parasite transmitted by the cattle ticks. According to the estimates, the ticks are thus directly responsible for an annual loss to stockmen in the United States of over $40,000,000. The new publication will propose methods for controlling the ticks. Popular descriptions and colored plates will be contained in the new bulletin.

Trees for Fence Posts. It is estimated that in this country more than one billion wooden fence posts are set each year. A very large number of these are cut from trees yielding less than five posts each. This great demand and rapidly disappearing forests have given a new impetus to forest planting in the Middle West. Hardy catalpa, black locust, osage orange, Russian mulberry and red cedar are being planted. The first three produce five inch posts in ten to fifteen years.

Insects as Carriers of Disease. This interesting subject was reviewed by A. E. Shipley, F. R. S., in a paper addressed to the scientists at the British Association, at Pretoria, last summer. The main points of the address are as follows:

The last few years are marked in the annals of medicine by a great increase in our knowledge of certain parasitic diseases, and above all, in our knowledge of the agency by which the parasites causing the diseases are conveyed.

Chief among these agencies in carrying the disease-causing organisms from infected to uninfected animals are the insects; and, amongst the insects, above all the flies. Flies, e. g., the common house-fly, can carry about with them the bacillus of anthrax. Flies, ants, and other even more objectionable insects, are not only capable of disseminating the plague-bacillus from man to man, and possibly from rat to man, but they themselves fall victims

to the disease, and perish in great numbers. They are active agents in the spread of cholera ; and the history of the late wars definitely shows that flies play a large part in carrying the bacilli of enteric fever from sources of infection to the food of man, thus spreading the disease.

The diseases already mentioned are caused by bacteria. But flies also play a part in the conveyance of a large number of organisms which are not bacteria but which, nevertheless, cause disease. In considering the part played by flies in disseminating diseases not caused by bacteria, we can neglect all but a very few families, those flies which suck blood having alone any interest in this connection. From the point of view of the physician by far the most important of these are the gnats or mosquitoes.

The parasite which causes malaria is conveyed by an insect, and, so far as we know, by one genus of mosquito only, the Anopheles. The malarial parasite lives in the blood-cells of man, but at a certain period it breaks up into spores which escape into the fluid of the blood, and it is at this moment that the sufferer feels the access of fever. Their presence and growth within the blood cells result in the destruction of the latter, a very serious thing to the patient if the organisms be at all numerous. If the spores be sucked up by an Anopheles, they undergo a complex change, and ultimately reproduce an incredible number of minute spores, each capable of infecting man again if it can but win entrance into his body by a mosquito bite.

Another elegant little gnat Stegomyia fasciata, closely allied to Culex with which until recently it was placed, is the cause of the spread of that most fatal of epidemic diseases, the yellow fever. The organism which causes yellow fever has yet to be found. It seems that it is not a bacterium, and that it lives in the blood of man. It evidently passes through a definite series of changes in the mosquito, for freshly infected mosquitoes do not at once convey the disease. After biting an infected person it takes twelve days for the unknown organism to develop in the Stegomyia before it is ready for a change of host. The mosquitoes are then capable of inoculating man with the disease for nearly two months. The period during which a man may infect a mosquito, should it bite him, is far shorter and extends only over the first three days of the illness.

Of the great obstacles which have for generations succeeded in keeping Africa, except at the fringes, comparatively free from immigrants, three, and these by no means the least important, are insignificant members of the order Diptera.

The third fly we have now to do with is the tsetse fly (Glossina), which communicates fatal diseases to man and to cattle, and to domesticated animals of all kinds. The members are unattractive insects, a little larger than our

common house-fly, with a sober brownish or brownish-grey coloration. The tsetse flies rapidly and directly to the object it seeks. Like the mosquito it is greedy and sucks voraciously. Unlike so many of the blood-sucking Diptera, in which the habit is confined to the females, both sexes of Glossina attack warm-blooded creatures. The fly always seems to choose a very inaccessible portion of the body to operate on, between the shoulders in man, or on the back and belly in cattle and horses, even inside the nostrils in the latter, or on the forehead in dogs.

The flies and mosquitoes which we have considered are found practically all over the world, but the genus Glossia is fortunately confined to Africa. Its northern limit corresponds with a line drawn from the Cambia through Lake Chad to Somaliland, somewhere about the thirteenth parallel of north latitude. Its southern limit is about on a level with the northern limit of Zululand. Even where the tsetse is found it is not uniformily distributed, but occurs in certain localities only. These form the much dreaded "fly-belts," where the normal prey of the fly is undoubtedly the big game of Africa.

The tsetse fly belongs to the family Muscidæ, the true flies, a very large family, which also includes our house-fly, blue-bottle fly, etc. These flies, unlike Anopheles and Culex, are day-flies, and begin to disappear at or about sunset. The practical disappearance as the temperature drops has enabled the South African traveller to traverse the fly-belts with impunity during the cooler hours of the night. At nightfall the tsetse seems to retire to rest amongst the shrubs and undergrowth; but if the weather be warm, it may sit up late; and some experienced travellers refrain from entering a fly-belt until the temperature has considerably fallen.

The sickness and death of the cattle bitten by the tsetse were formerly attributed to some specific poison secreted by the fly, and injected during the process of biting. It is now, largely owing to the researches of Colonel Bruce, known to be due to the inoculation of the beasts with a minute parasitic organism conveyed from host to host by the fly. The disease is known as "nagana," and the organism that causes it is a species of Trypanosoma, a flagellate protozoon or unicellular organism, which moves by means of the lashing of a minute, whip-like process. It is from the big game that the disease has spread. In their bodies the harmful effect of the parasites has, through countless generations, become attenuated; but it leaps into full activity again as soon as the Trypanosoma wins its way into the body of any introduced cattle, horse, or domesticated animal.

The report of Colonel Bruce, which has just been issued, shows that the sleeping sickness which devastates Central Africa, from the west coast to the

east, is also conveyed by a species of tsetse fly. In one year the deaths in the region of Busoga reached a total of 20,000, and it is calculated that although the disease was only noticed in Uganda for the first time in 1901, by the middle of 1904, 100,000 people had been killed by it.

Finally, we come to a last class of diseases which is of the utmost interest to the agriculturist and settler, and yet at present it is but little understood. These diseases are caused by various species of a protozoon named Piroplasma, and the diseases may collectively be spoken of as piroplasmosis. When they are present in cattle they are spoken of in various parts of the world as Texas fever, tick-fever, blackwater and redwater. Heartwater in sheep is a form of piroplasmosis. Horses also suffer, and the malignant jaundice or bilious fever which makes it impossible to keep dogs in certain parts of Africa is also caused by a piroplasma. Finally, under the name of Rocky Mountain fever, spotted or tick-fever, the disease attacks man throughout the west half of the United States. We have seen that the carrier or "go-between" in the case of the malaria is the mosquito, and in the case of the sleeping sickness is a tsetse fly. Piroplasma, however, is not conveyed from host to host by any insect, but by mites or ticks, members of the large group of arachnids, which includes besides the mites, the spiders, scorpions, harvestmen, and many others.

I will not weary you with more diseases. I think I have said enough to show that within the last few years a flood of light has been thrown upon diseases, not only of man and his domestic animals, but upon such insignificant creatures as the mosquito and the tick. I have tried to show how these diseases interact, and how both hosts are absolutely essential to the disease. We can now to a great extent control these troubles; the old idea that there is something unhealthy in the climate of the tropics is giving way to the idea that the unhealthfulness is due to definite organisms conveyed into man by definite biting insects. We have at last, I think, an explanation of why Beelzebub was called the Lord of Flies." *Nature* 73: 235–238. Jan. 4, '05.

NEWS NOTES

Prizes in Nature-Study. The North Carolina Nature-Study Society offers to members several prizes for this year, some for schools and some for individuals. (1) Best collection of seeds, named and mounted. (2) Essay on "Our Oaks." (3) Essay on "Our Pines." (4) Map showing soils, with specimens. (5) Collection of insects. (6) Tests of vitality of seeds. (7) Collection of moths and butterflies hatched from

cocoons by exhibitor. (8) Best corn plant. (9) Best cotton plant. Full information concerning rules and prizes may be obtained from Professor F. L. Stevens, Secretary of the Society, Raleigh, N. C.

New College Course in Nature-Study. The new agricultural college founded by Sir William Macdonald and to be located near Montreal will give special attention to training teachers of nature-study and elementary agriculture. Professor Lochhead, of the Ontario Agricultural College, will take charge of biology and nature-study in the new college. Professor James Robertson, formerly Dominion Commissioner of Agriculture, will be president.

North Carolina Nature-Study Society. This Society which was formed two years ago has steadily grown until it now numbers nearly one thousand members, and each week a number of new names of teachers from North Carolina, and often from other States, are added to the membership roll.

Value and Methods of Nature-Study. Professor J. W. Shepherd, of the Chicago Normal School, addressed a conference of educators and others at a recent meeting in the Municipal Museum, Chicago. His address contained the following points concerning the value and methods of nature-study : (1) Nature-study, to gain admission to the school curriculum, must furnish a working contribution to child life,—must result in doing. (2) The contribution is two-fold, (a) Character producing (ethical), and (b) Information giving. (3) "a" in 2 is best attained when the children recognize the validity of individual and community life in plants and animals and make their investigation accordingly ; "b," by learning fundamentals about plants and animals and simple physical principles that will enable the children to make their physical surroundings better. (4) In nature-study children should work with actual things, under the stimulation of some problem to them.

Nature-Study in a Sanitarium. Mr. E. M. Brigham, who has traveled extensively in South America, has been appointed nature-study instructor in the Sanitarium at Battle Creek, Michigan. This is the largest institution of the kind in the world, all the time having from 600 to 1000 patients. Every day, no matter what the weather, Mr. Brigham takes a big party of patients on an outing, and upon returning gives them a natural history talk. The plan is proving a great success, and the physicians of the institution find that it pays to employ a permanent instructor in nature-study, especially because it helps in keeping the patients out-of-doors in the fresh air many hours a day.

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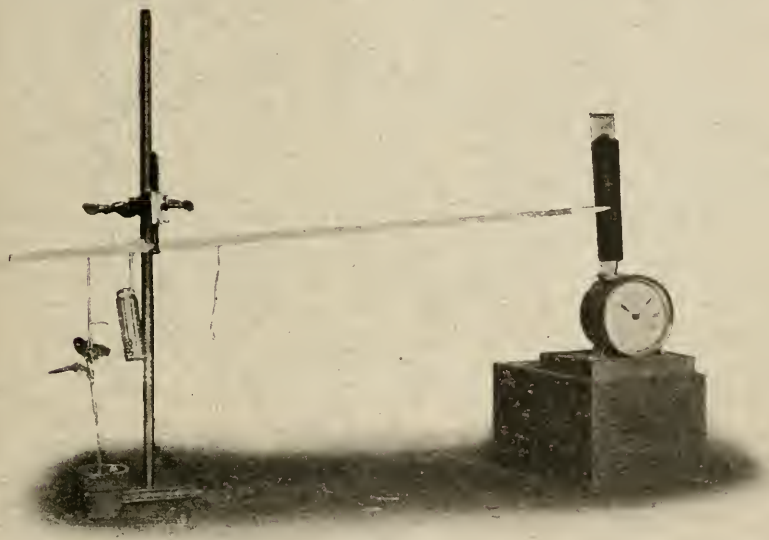

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THE NATURE-STUDY REVIEW

Vol. 2, No. 3
WHOLE NO. 9.

March, 1906

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

CONTENTS

	PAGE
School Gardens. B. M. DAVIS	81
Nature-Study and Manual Training. M. A. BIGELOW	91
The Sap-Current: An Experiment. Illustrated. F. L. STEVENS	96
Nature-Study in City Primary Schools. M. C. DICKERSON	98
Galls and Gall-Flies, Illustrated. V. L. KELLOGG	109
Nature Notes	115

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SOME GOOD OPINIONS FROM READERS

[EDITORIAL NOTE.—The following notes taken from our letter files show what prominent educators think of THE REVIEW. With possibly five exceptions, these quotations are from people who are well known in the scientific and educational world, especially as advocates of nature-study for schools. Since the letters were not written for advertising purposes we do not take the liberty of printing names, but the Managing Editor will send the list of the names to any one who wishes to know who are some of the prominent friends of THE NATURE-STUDY REVIEW.]

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COLLABORATORS OF NATURE-STUDY REVIEW FOR 1906

More than one hundred and seventy-five well known teachers and men of science in the United States, Canada, and Great Britain have promised their help in the literary affairs of The Review for 1906. The original list of collaborators, including about sixty names, was published on the cover pages of all issues for 1905 ; but as suggested in an editorial in No. 2, March 1905, the hearty support which the new magazine received from all leaders of nature-study made it impossible to continue to publish a complete list of collaborators. Hereafter the lists of signed articles already published, which will appear regularly on the advertizing pages, may be referred to for the names of contributors, and special lists of those who promise articles will be printed in certain issues.

Referring to our letter files containing communications from over three hundred men and woman who are commonly believed to be most prominent in nature-study as an educational movement in the United States and Canada, we find that without exception all express great interest in the THE NATURE-STUDY REVIEW and promise to contribute their best ideas. It seems fair to state that in the beginning of its second year THE REVIEW has become in reality a coöperative magazine to which all advanced workers in nature-study will contribute their best results and conclusions for record, dissemination and comparison. If the future holds in store any good things in the line of nature-study, readers of this journal may be sure that, with active collaborators in every state and province of the United States and Canada and in all important educational institutions, THE REVIEW will not fail to give timely accounts of important advances.

THE NATURE-STUDY REVIEW

CONTENTS OF NO. 1, JANUARY, 1906

The Evergreens, ANNA B. COMSTOCK. What to teach in Nature-Study, L. A. HATCH. Gold-Fishes in Japan, K. MITSUKURI. Definite Problems in Nature-Study, S. B. SINCLAIR. A Simple Experiment on Spontaneous Generation, F. L. STEVENS. Sunflowers for Gold-Finches, DELIA M. HALE. Science and Nature-Study Parallel, W. M. HALLOCK. Scientific Nature-Study Abstract, M. A. BIGELOW.

CONTENTS OF NO. 2, FEBRUARY, 1906

Nature-Study and Manual Training, W. A. BALDWIN. The School-Garden at Bowesville, Canada, E. A. HOWES. Nature-Study in its Practical Bearings, J. P. STEWART. Place of Physiology in Elementary Schools, M. A. BIGELOW.

THE NATURE-STUDY REVIEW

CONTENTS OF No. 1, JANUARY, 1905

Nature-Study and Natural Science—A Symposium, H. W. Fairbanks, C. F. Hodge, T. H. Macbride, F. L. Stevens, M. A. Bigelow. Physical Nature-Study, John F. Woodhull. Nature-Study and Elementary Agriculture in Canada, W. H. Muldrew. Some Recent Criticism of Nature-Study, F. M. McMurry and H. E. Armstrong. Agriculture in Southern Schools, C. W. Burkett. School-Gardens at Hartford School of Horticulture, H. D. Hemenway. Ant-Nests for Schools, Adele M. Field. Guide to Periodical Literature, Ada Watterson.

CONTENTS OF No. 2, MARCH, 1905

Educational Values and Aims of Nature-Study, S. Coulter, H. W. Fairbanks, M. A. Bigelow. Principles of Nature-Study, J. M. Coulter. Children's Gardens at Worcester, Mass., Illustrated, Edna R. Thayer. Why Some School-Gardens are Failures, T. R. Croswell. Chemical Tablets for Feeding Plants Growing Without Soil, Illustrated, Edward F. Bigelow. A Nature-Study Lesson with Moulds, F. L. Stevens. Nature-Study in High Schools, M. A. Bigelow. Guide to Periodical Literature, II., Ada Watterson.

CONTENTS OF No. 3, MAY, 1905

Why Many Fail in Teaching Nature-Study, L. A. Haigh. Ready-Made Lessons in Nature-Study, L. C. Miall. Flower Shows in City Schools, Alice R. Northrop. Observation Bee-Hive for the Schoolroom, Anna Botsford Comstock. Window Gardens for the Schoolroom, H. D. Hemenway. A Wild-Flower Garden, Isabella G. Diggings. Making a School Lawn, Margaret T. Brown. Time Required for Nature-Study, S. B. Sinclair. Method of Sherlock Holmes in Nature-Study, E. A. G. Lamborn. Original Observations from Elementary Schools. Guide to Periodical Literature, III, Ada Watterson.

CONTENTS OF No. 4, JULY, 1905

Nature-Study versus Agriculture, W. M. Hayes. Nature-Study and Agriculture, Anna Botsford Comstock. Nature-Study and Agriculture, F. L. Stevens. Nature-Study in School of Nova Scotia, A. H. MacKay. Teaching Facts in Nature-Study, John Dearness. Nature-Study and its Relation to English, W. M. Heiney. The Silk-Worm for Nature-Study, Alvin Davison. Protective Colors of Animals. Facts Discovered by Children, T. D. A. Cockerell. Guide to Periodical Literature, IV., Ada Watterson.

CONTENTS OF No. 5, SEPTEMBER, 1905

Relation of Geography to Nature-Study, with Complete Outline of Courses for Eight Grades, H. W. Fairbanks. Value of Knowing Names of Natural Objects, Many Writers. An Educational Bee-Hive, Edward F. Bigelow. Do Birds Eat Butterflies, T. D. A. Cockerell. School-Gardens in Philadelphia. School-Garden Notes, H. D. Hemenway. A Plea for Wild Flowers. An Appeal for the Birds. Nature-Study in New Zealand. Nature Notes.

CONTENTS OF No. 6, NOVEMBER, 1905

The Communal Life of Ants, Illustrated, Adele M. Fielde. Study of Deciduous Trees in Winter, Clarence M. Weed. The Children's School Farm in New York City, Illustrated, Fannie Griscom Parsons. Temperance Physiology Sixty-six Years Ago, M. A. Bigelow. Plants That Hide from Animals, M. A. Bigelow. Facts Discovered by Children, Marion H. Carter. Guide to Periodical Literature, Ada Watterson Yerkes.

MANY MORE SUBSCRIPTIONS NEEDED

In order to pay the cost of publishing the nine numbers of THE REVIEW for 1906 very many more subscriptions at $1 each will be required. The above statement is based on an estimate which does not include the cost of the business management, which has from the beginning been carried by a secretary under the direction and at the expense of the Managing Editor, who has acted as publisher because regular publishing houses wish to charge for office expenses and profits several hundred dollars more than the salary of a secretary.

It is absolutely necessary that THE REVIEW should be made nearly self-supporting this year and completely so next year. *Do the numbers already published convince you that there is a need of such a journal, and will you co-operate by subscribing and by recommending it to others?*

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THE
NATURE-STUDY REVIEW

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

VOL. 2 MARCH, 1906 No. 3

SCHOOL-GARDENS

BY B. M. DAVIS

State Normal School, Chico, California

[Read before the California State Farmer's Institute in joint session with the California Teachers' Association, December 26, 1905.]

I wish to discuss two phases of my subject: (1) its relation, together with nature-study. to the curriculum ; (2) its practice (a) in the cities (b) in the country.

The school-garden is the outdoor laboratory for carrying on just such work in elementary agriculture as has been called to your attention. It is a huge slate where problems in plant growth may be put on and then rubbed out and new ones put on. There can be little doubt in the minds of any of us who have listened to the interesting address[1] and the interesting discussion following it that this is a desirable form of school activity. Yet whatever progress the school-garden movement has made in this country has been against the same protest that is often raised against other new subjects : "The curriculum is already too crowded."

This attitude of the teacher, and especially of those who make courses of study. is readily understood when we recognize the fact that the course of study, as we find it in this country, is not a pro-

[1] "Why the Friends of Agricultural Products Believe that Agriculture Should be Taught in the Public Schools." A. C. True, Director Office of Experiment Stations, United States Department of Agriculture, Washington, D. C. Discussed by : E. W. Hilgard, Professor of Agriculture, University of California ; L. D. Harvey, Superintendent Stout Training Schools, Menomonie, Wis.; T. O. Crawford, County Superintendent of Schools, Oakland ; R. L. Beardslee, Assemblyman Twenty-third District, Stockton ; et al.

duct of development or evolution but rather the product of accretion. There has been much added to the formal studies with which it began. Adaptations to the more complex demands of society have not been made by adjustment but by addition, until now the curriculum is fearfully over-crowded. For this reason the present scheme seems to some of us to be deficient in several important respects. In order to see the bearing our subject has in general on the curriculum it will be worth while to notice briefly some of these deficiencies:

(a). In the present scheme there is little or no opportunity for practical experience in the use of formal studies. The method generally in vogue is the drill method to the exclusion of a working method. Formal studies are mere tools for working out life problems. Yet there is little or no practice in the use of them as such. For example: Arithmetic is taught mainly by the use of hypothetical situations instead of actual situations. There are about five years devoted to this subject in the elementary schools, but when the average child gets through he is not as efficient in its practical use as one who has spent three months in a good business college.

(b). There is little or no opportunity for acquiring new experiences. It is assumed that the pre-school life of the child and his life outside of school hours are sufficient to afford concrete data for the development and understanding of all school subjects. This deficiency has long been recognized, as is shown in the various attempts to introduce object studies. These attempts have failed, for the most part, because the objects have not really entered into the child's active life. In school the natural method of acquiring knowledge by direct experience is suddenly dropped and an entirely new method substituted—the book method. Learning words takes the place of real knowledge.

One time I undertook to find out just where in the school life of the child this method began to make itself felt. I was surprised to find it stunting natural expression as low as the second grade at the very beginning of the use of written language to convey thought. The children of this grade had been very much interested in their little gardens. I requested their teacher to have them write just how they took care of their gardens. Here are two little essays that illustrate the result:

"I planted some seeds in my little garden. I have a nice garden. Is your garden nice? Did you plant some seeds in your garden? I planted some in mine." *Clara.*

"I have a little garden of my own. I spade up my garden before I do anything else and then break up the clods, and then make little trenches and then put in my seeds not very deep. It rained once. Mine I planted in lettuce and radishes. We have to cultivate it so that the water could stay in." *Teresa.*

This latter is a beautiful little essay. The child had something to say and said it in a simple way. Her writing was poor and her punctuation bad, but she used her writing English as a means of expression. Clara's writing was very good, her punctuation perfect, but the formal side of expression had been so emphasized that she failed to use her language as a tool for expression. Clara's essay was typical of the whole class with the one exception that I have just indicated. Thus through the grades and high school and college the number of Claras is great, but occasionally there is a Teresa who insists on having real experiences and telling about them in a clear way.

(c). There is little or no incentive for the child to acquire new experiences outside of school hours. The lack of wholesome interests of children outside of school hours leads to forms of activity which often result, especially in groups of boys, in pure vandalism. This fact is at the bottom of a vital social problem, but is generally overlooked. The boy has a tremendous amount of energy and enthusiasm which he must expend. If undirected this energy may not only be expended in the wrong direction, but in taking the wrong direction the boy may become unfit for useful membership in society.

"In Dayton, Ohio, the boys known as "Slider-town tuffs" made the district about the factory of the National Cash Register Company so unpopular that building lots sold for three hundred to four hundred dollars apiece. Soon after the establishment of gardens the children were so cured of stealing that the same lots sold for from nine hundred to fifteen hundred dollars each[2]." This is but one illustration of a great many showing the influence of wholesome interests.

(d). In many places the curriculum utterly fails to give the preparation for life that is demanded by the community in which the school is located. This is especially true in the rural districts where the school work is fashioned after the city type. Here more than anywhere else is the book-method used. There is little attempt to make

[2]H. D. Hemenway, "Results of School Gardening." Mass. State Board of Agriculture, Nature Leaflet, No. 32, p. 6.

use of the industrial and natural environment of the school. The chief aim seems to be to prepare the pupils for county examinations.

(e). There is not enough attention given during the school life of the child to the promotion of general human interests—interests that affect fundamentally all classes of people. I mean the sort of public spirit that develops human sympathy and a truer democracy; the kind of interest that has already expressed itself in such organizations as the National Irrigation Congress, American Civic Association, and the like. This interest cannot be developed by mere talking. For example, the value of irrigation and conservation of water can not be appreciated by talking about it. But actual experience in the practice of irrigation in which the principles are involved should go a long way in making the child a citizen who, whatever his business or profession may be, will have an intelligent interest in the subject.

There is no more vital human interest than that centered around the activities connected with plant propagation. If the child is to become a business man he should have some appreciation of the great work done by the farmer, and express it in a way that will make the life of the farmer richer and fuller. But he can not be expected to have this appreciation unless he has had some experience in common with the farmer. If the child is to be a farmer, he should be able to appreciate those things that make for the greatest success in his own work. To do this he must know the value of expert opinion; how to use the state and government publications: he must take an intelligent interest in the means of exchange of ideas, such as farmer's institutes and the like. He owes to the world the best that the earth may bring forth. The world owes him sympathy, encouragement, and protection.

I have apparently strayed a long way from my subject but I think that it will be seen that with these facts before us we are in a position to uuderstand the need of some subject or some reorganization of the school work that will strengthen the curriculum in these respects.

I do not wish to claim too much for nature-study, but experience has shown that nature-study of the right sort is able to do a great deal toward this end: It has been able to vitalize the formal studies in many ways by making them efficient tools for the child to accomplish his purposes. It has been able to project experience-getting into the school life of the child so as to give life and significance to much that would be otherwise meaningless. It has been able to establish wholesome interests outside of school hours to such an extent in some

instances as wholly to transform communities. It has been able to show children of the country that they may do something worth while right where they live, and make them content with their country life. It ought to do much toward bringing about a wider human sympathy by stimulating interests in nature which everyone has really at heart.

The place of the school-garden in the elementary schools is to furnish a rational or working basis or center for a great deal of the work included in nature-study. Much of the failure of nature-study to accomplish what it ought has been due to its fragmentary character. Its greatest success as a school subject has been where the child's activities have been enlisted in the real business of his life. The business of rearing plants involves more of nature than almost any activity in which the child may participate. The problem of school gardening for the teacher is to make it the center of as large and varied a circle of activities as possible. He is thus able to make much of the formal work of the school seem worth while to the child, thereby increasing the efficiency of his work. This gain in efficiency and interest in itself is, to my mind, sufficient to meet objections as to lack of time, crowded curriculum, etc. This idea has been excellently worked out in some schools, notably in the State Normal School, Hyannis, Mass.

The method of using the school-garden and the point of view in its use as part of the school equipment depend, of course, on the situation of the school. In the city school the aim is social rather than economic. The success hitherto attending children's gardens in cities has been greatest where the social aim was the only aim. Experience has shown that the gain in civic conscience, which reduces vandalism and destructive activities, would be more than sufficient to meet all expenses.

Dr. B. T. Galloway says of the Washington, D. C., gardens: "Civic pride is taught and respect for the property rights of others is learned. While stealing and vandalism were weekly occurrences the first summer the gardens were in existence, not one case was reported during 1904. . . . The point of view from which Washington approached the work has been that of arousing civic pride by giving better school surroundings and improvement of backyards."

The work of this nature that has attracted the most attention in the United States is that of Mrs. Henry Parsons, in New York City.[3] In 1902 she began the work of transforming a city desert of

[3] See this journal, Vol. I, No. 6, November, 1905.

about seven acres, lying in the midst of one of the worst tenement districts of the city. In transforming this city waste she hoped to transform the lives of the children of this district. From the day the real work began the interest was intense. A three-foot high fence, on which adults could lean comfortably and see everything happening in the garden, satisfied their curiosity, that strongest of human traits. Every one realized that only the limited space excluded many others from the delights of gardening, so that the neighborhood was led to feel that it was "our farm." Courtesy, justice, and pride in the work were stimulated to the utmost, and proved most effective discipline. The only real punishment was banishment. This work of Mrs. Parsons is almost beyond belief. The dumping ground of material refuse and the dumping ground of refuse humanity became on the one hand a garden, on the other an uplifted community. All of this was done with very little assistance from the city. But this year (1905) $5000 were appropriated for continuing the work.

According to H. D. Hemenway (in "School-Garden Notes," THE NATURE-STUDY REVIEW, vol. I, p. 219) more than 100 cities and towns in the United States have school-gardens connected with at least part of their schools.

My own experience is in common with the experience of all who have engaged in this work. It does not stop with the school. Children carry the interest home and change the most unpromising situations into places of beauty, but best of all this wholesome interest reacts upon their lives, making them useful members of society.

In addition to this general aim, childrens' gardens may contribute in other ways to the school equipment. It furnishes the only practical means for handling nature-studies in a city. It makes the city park, which is but an expression of human interest in nature, more of an educational factor. It furnishes much of the illustrative material otherwise given by charts and pictures. Indeed the amount expended in these devices would in many instances maintain a school-garden. California is especially fortunate in this particular. Almost every product of commercial value that comes from the earth may be grown here.

In the rural school the aim is both social and economic. It is social in the sense of creating wholesome interests in country life. It is economic in the sense of stimulating activities along the line of the actual business of the community. Somehow the impression has

gone abroad that school-gardens are only for the cities. This is a great mistake. The chief difference in the two situations lies in the character of the work. If elementary agriculture is ever to become efficient in the country schools there must be a place for its practice. As I have said, the school-garden is the laboratory for such practice. School-gardening in the country, therefore, has a broad significance and refers to any work directly or indirectly concerned with rearing plants. The country child has vastly more experience in this sort of work than the city child has. He would not be content to do what the city child finds of great interest. But he *is* ready to take up definite problems relating to the growth of plants and to do those things that will help him to understand work that he has been doing or sees his father doing.

There are two factors in the work of a successful farmer : one is the business of production ; the other the business of disposal of his products to advantage. He must combine the ability of a scientist with the acumen of a business man, and the latter is already seeing the benefit of scientific methods of procedure. In this state (California) the great fruit-canning concerns send experts into the field. Each one begins to report upon the conditions of the crop even before the trees begin to blossom. These reports are continued for every stage in the production of fruit so that long before the fruit ripens, the total production of the state is known almost to a certainty. The farmer is at the mercy of this knowledge.

And the farmer makes almost as little use of the things that ought to contribute to the other factor of his success. Among the mass of those engaged in farming there is a surprising amount of intolerance for expert opinion based upon scientific methods of study, and when this opinion is called into service the results are expected to be shown immediately in dollars and cents. I believe that the intelligence which will make for greater efficiency in agricultural pursuits in this state is the same sort that makes for efficiency in other pursuits, viz.: an intelligent appreciation of expert and scientific work, and the ability of the individual to protect himself from imposition. Progress can only be made along these lines. A few illustrations will help to make clear what I mean.

I have already referred to the inspection of developing fruit crops. I see no reason why the farmer should not have this knowledge at his disposal and at least know whether or not he is getting a fair price for his fruit.

In a certain county where bee-culture is an important industry, great losses have occurred, due to the death of bees in the midst of the honey-making season. Year after year this loss of bees has been repeated. Lately the government was called upon for aid in the matter. An able man who thoroughly knows his business was sent to this county to study the situation. He soon found two things which were sufficient to account for the trouble: careless handling of the bees which induced robbing, and the presence of a considerable number of poisonous weeds in the neighborhood of the apiaries. The remedies were very simple: careful handling of the bees and the destruction of these weeds. This report and the simple remedies were not well taken. The "bee-men" expected a report showing that some mysterious microbe was causing the trouble, and almost felt hurt when it was clear that such was not the case. Most of the men will continue to handle bees in the same old way, until forced by competition with those who are more appreciative of expert suggestions either to adopt better methods or to go out of business.

Not long ago the entomologist of the experiment station at the University of California was called upon to visit a certain peach-growing section of the State where the peach worm was threatening the crops. After a careful study, a course of procedure involving the use of a particular kind of spray was recommended. About this time an agent for another spray came along which he represented to be much better and cheaper than the other. Many orchardists bought of the agent, some used no spray, and some took the advice of the entomologist. The result as shown by the fruit crop is about as follows: Those orchards on which the agent's spray was used yielded 45 per cent good fruit; those on which no spray was used yielded 50 per cent, or 5 per cent more than those treated by means of the agent's preparation; and those on which the spray advised by the entomologist was used yielded 90 per cent.

The wheat industry in California has deteriorated greatly both in yield in bushels per acre and in percentage of gluten. Year after year the same ground is put in wheat and very little attention is paid to the selection of seed. A year ago $10,000 were appropriated to carry on work for the betterment of the wheat raising industry. This should have been done long ago, and will do little good now unless there is a better disposition on the part of the farmer to accept the results of intelligent investigation.

These are a few random instances of many that might be given

bearing on the educational problem relating to agriculture in our State. The present agricultural educational system, *i. e.*, experiment station, agricultural college, and farmer's institute, is doing its part. Secondary education in agriculture, so far as it has had a chance, is doing its share. But the part of our system that reaches the masses is doing practically nothing in this direction. It is to the elementary or common schools that we must look for the next important contribution toward the solution of the problem.

Elementary agriculture as a school subject will probably fail wherever it is taught from books, and the average teacher knows no other way of developing a subject. The country school-garden means simply a part of the school equipment for bringing the child face to face with some of the great fundamental facts relative to plant growth. These facts present themselves as interesting exercises to be worked out by the child's own efforts. I would have the children have a part in the solution of some of the problems that vitally concern the people of our state. The energy of a few men and the expenditure of $10,000 represents the present effort to improve the wheat. Why not direct the energy of the children in the wheat growing districts to the problem of selection of seed wheat? The Canadian school children undertook to improve the seed of wheat and oats, and in three years the gain was 27 per cent for wheat and 28 per cent for oats. It is not exaggeration to say that the children forced their fathers to begin systematic and intelligent effort to improve their seed under direction of Superintendent of Agriculture Robertson. Indiana has recently had a phenomenal yield of corn. The children are going to make it possible for a still greater yield in the future. In many corn raising counties corn contests are being held by the children. By this means the quality of seed will surely be raised, and better than this an appreciation of careful seed selection will be aroused as never before. Local problems, such as testing the soil as to its adaptation for culture of sugar beets, statistical studies of fungus diseases of oats,, and the like have been worked out in many places.

My idea of school-gardens for California children in the country is that the gardens should be centers for just such work. Every boy may become in a small way a Burbank. One of the secrets of Mr. Burbank's success is the great number of plants experimented upon. What might 100,000 children do? Out of the sum total it is not too much to expect that something new and useful might result

from their efforts, while the reaction upon the children and indirectly upon the parents would certainly be a great educational gain.

Children, after a little practice, can bud and graft trees quite as skillfully as the average nurseryman. I have noticed that the ability to do this comes to them as a revelation, and they immediately begin to try improving the fruit at home. Bulletins are sent for and read with interest and pleasure and the parents themselves become interested.

I have only time to suggest a few lines of work by way of illustration, worth while in themselves, that might be undertaken : (1) There are many things that the entomologist of the State University would like to know ; for example, the grasshoppers often totally destroy the vegetation in certain regions, and nobody seems to think of the grasshoppers until they have reached that stage in their development where man's efforts are practically futile against their ravages. Suppose the children knew the life-history of these insects, where they breed, etc., and could give warning in time for the insects to be confined to their breeding grounds. If this had been done in the spring of this year enough money would have been saved to more than pay all the school expenses of these grasshopper-infested regions. (2) Children are naturally interested in birds. The study of the feeding habits of birds, and planting trees and shrubs in the schoolyard where birds may come for food and shelter would be an object lesson to the fruit grower who seeks to protect his fruit by destroying the birds. (3) This experience in planting and caring for trees would at the same time not only make the yards more attractive but introduce a subject which is of most vital interest to every Californian, *forestry*. (4) Testing soils and making soil surveys ; methods of irrigation ; the selection of useful varieties of plants adapted to the locality of the school ; and many other lines of work might be mentioned. I have suggested enough to indicate what I mean by school-gardening as applied to rural schools. But there are other things involved in the work : Government and State publications will have to be written for and read ; records will have to be made and consulted ; various practical uses of arithmetic will have to be made ; maps and drawings must be employed ; all this and more is necessary to make the work a success. Throughout all, there is this greatest of incentives for endeavor, helping in a great and valuable world work.

These possibilities are not imaginary. Enough has already been done (e. g. in certain districts in Canada and other places) to show

that it may be put into successful practice. Elementary agriculture may not be forced upon the schools by legislation but interested teachers, working along the lines just indicated, may prepare the way for the elementary schools to do their share in raising the life of rural communities to a higher social and economic level. In so doing the other forces already active will be able to do better and more effective work.

The school-garden as an outdoor laboratory has almost unlimited possibilities. It fulfills the highest function of nature-study by being a center of activity whereby the children may "learn those things of nature that are best worth knowing to the end of making life better worth living."

CORRELATION OF NATURE-STUDY AND MANUAL TRAINING

BY MAURICE A. BIGELOW

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[A paper read before the Eastern Association of Manual Training Teachers, Newark, N. J. July 1, 1905.]

It is chiefly in the line of methods of teaching that manual training and nature-study come into contact. It is now generally agreed by leaders of nature-study that it must be taught by actual examination of natural things themselves. This, the laboratory method of higher education, means handling plants, animals, and lifeless objects in order to learn through the senses. It is decidedly an active method as compared with ordinary teaching. In short, the nature-study method consists largely in *learning by doing*. Of course, the best teachers of nature-study will not depend entirely upon the learning-by-doing method. Some supplementary didactic teaching is necessary and valuable; but the foundation of all real nature-study and of every good nature-study lesson is in the actual "doing things" with natural objects which the pupils have before them. It is in this method of learning by doing, by the pupils' own activity, that we find close similarity between nature-study and manual training, and here in method is the real basis for the most important correlation between the two subjects. The problems of correlation involved are largely those of relating the activities of nature-study and manual training.

The best nature-study courses consist in two distinct kinds of work: (1) that adapted to the schoolroom, (2) that for outdoors. In each

of these phases of nature-study work there are possible points of contact between nature-study and manual training where each subject may by association add interest and efficiency to the other. Let me review the indoor and outdoor nature-study work briefly by way of noticing some illustrations of possible correlations.

The indoor nature-study work consists chiefly in examining a great variety of living and lifeless natural objects brought in from nature out of doors. In these studies there are many opportunities for limited correlations with manual training; for example, there are leaves and flowers to be pressed, mounted, and blue-printed, and the making of plant-presses, simple cages for pets, boxes for arranging specimens, and similar hand-work suggested by the nature-study lessons. In the physical phase of nature-study there is much more opportunity for correlating with manual training, because physical nature-study involves many simple experiments which require apparatus easily constructed in the manual training shop. For example, the first weather observation in connection with nature-study suggests making wind-vanes and windmills. In the grades above the fourth the appropriate physical nature-study requires dozens of pieces of simple apparatus which could be made by the pupils in connection with their manual training exercises.

I have suggested a few examples of possible correlations between manual training and indoor nature-study, but in general the possible connections between manual training and schoolroom work in nature-study are limited if we do not go far afield in search of correlations. To make use of any but the very natural correlations would, I am convinced, not be for the best interests of nature-study.

The outdoor work in nature-study, offers far greater possibilities for correlation with manual training. Most prominent of the outdoor nature-study of the best schools is the work of the school-garden, which more than any other phase of nature-study stands for active education. The connections between manual training and the nature-study of the garden lie in two directions: (1) There are many utensils of wood and iron needed in the school-garden which may be constructed under the direction of the manual training department. (2) There ought to be great manual training value in a large part of the practical operations in the garden.

Concerning the first point I need say little, for you are all doubtless familiar with schools in which the children make as part of their manual training work such articles as stakes for garden beds, meas-

uring rods, plant labels, envelopes and boxes for seeds, baskets for the garden produce, and many simple tools useful in the garden.

With regard to the second point, the manual training value of garden operations, it has always seemed to me that carefully laying out a garden bed and then carefully preparing the soil there ought to have manual training value quite similar to that in some of the simplest work with wood and metal. In most gardens the one aim of teachers and pupils is to get the soil rapidly into condition for planting without attention to *how* the work is done. Most plants selected for school-gardens are so hardy that they will grow in beds very roughly finished, and so all too commonly the loosening of the soil is the one essential insisted upon, and the neatness of the finished garden is likely to escape attention because seeds will grow in crooked rows and in beds three feet wide at one end and two and one-half feet wide at the other. From the nature-study point of view, which in this case is simply concerned with growing plants, such carelessness in planting might be regarded as of little importance ; but here is an opportunity for manual training value which should not be neglected. It will surely add to the interest and value of the nature-study work. Pupils ought to be encouraged to look with pride upon garden beds neatly laid out and planted, just as they should be proud of a board neatly planed or of a nail driven straight. I believe it is worth while to give attention to the use of garden tools so that the pupils will learn to use them properly just as in shop-work they learn the proper use of the hammer, saw, etc. It seems to me that in the lines which I have indicated there are manual training values in close connection with the nature-study of the school-garden which deserve to be worked out better than even the few exceptionally progressive schools have so far done.

In adjusting nature-study and manual training in a plan for correlation some interesting problems come forward. In some schools manual training is the prominent subject and the attempt is to adjust nature-study to the manual training. I have seen a case where a three days' visit gave me the impression that nature-study was maintained in that school in order to afford opportunity for manual training exercises. I have seen other schools in which there was little manual training except that in connection with the nature-study. Better than either of these plans, it seems to me, is to develop the general outlines of both nature-study and manual training quite independently so far as strict following of the fundamental principles of

each of these subjects is concerned, and then make the correlations which do not interfere with the general scheme of either subject. Such correlations will nine times in ten necessarily be made by adjusting the manual training to nature-study, for the following reasons: Nature-study, as it is interpreted by the present leaders, is directly based on materials from nature and is therefore bound by nature's time and order of supplying such materials. Nine-tenths of the most valuable nature-study is determined by the order of the seasons, and materials must be studied when the natural progress of things makes them available and not when some arbitrary school program calls for them. It is conceivable that some teachers might have good reasons for placing such work as making paper envelopes for seeds or stakes for garden beds in some year or part of a year other than that which is most naturally connected with the nature-study. If in such a case the manual training cannot be adjusted to the nature-study, then let both subjects be conducted each for its own sake and without thought of making direct connections between them. In a case where in a primary grade the nature-study might suggest making something which involves manual training principles not yet known to the pupils, do not anticipate the manual training. For example, in some schools a study of birds in the first grade might suggest building bird-houses; but anything resembling a satisfactory bird-house would certainly involve manual training operations too difficult for such young pupils. For this and other reasons I would get around this particular difficulty by studying birds in a grammar grade as well as in a lower grade, and the older pupils might make an interesting connection between their nature-study work of birds and their manual training work.

In passing, let me call attention to the bird-house as another example of nature's order determining the adjustment of nature-study and manual training. The time to build a bird-house is, of course, in the late winter, just before the birds are expected to arrive and occupy such houses, and not in the autumn term when there can be little natural interest in bird-houses.

In discussing correlations between nature-study and manual training we should not overlook the primitive-life studies which have become prominent in many schools. These studies appear to be an attempt to make elementary education at bottom active education, and hence manual training is prominent in them. Some educators have enthusiastically looked upon primitive-life studies as affording a unifying principle for primary education, and certainly some interesting cor-

relations have been centered around the manual training activities connected with these studies. But nature-study can not be satisfactorily adjusted to such a scheme, for the following reasons : Nature-study deals with the nature with which pupils of today are in contact. It is only in so far as primitive-life studies are illustrated by things now existing that there can be any close relation between nature-study and manual training ; and these are the same relations which existed long before primitive-life studies were suggested for the primary curriculum. Could we teach primitive-life studies with the pupils in the natural surroundings which touched primitive man, then I see how we could make a very complete connection between the active education of nature-study and that of manual training on the primitive-life basis. But unfortunately primitive nature is not available and for the purpose of primitive-life studies the imagination supplies it. True nature-study can not be based on things imaginary. I think that we must admit that here is a gap that only correlation gone mad could be expected to bridge ; and hence I see no hope that primitive-life studies will aid in bringing the nature-study and manual training of the primary grades closer together.

In conclusion, I want to urge that nature-study needs all the help which it can get from legitimate correlation with manual training. While in general there appears to be no deep and fundamental basis for anything approaching a complete system of correlation between the two subjects, we have seen that there are numerous possibilities for correlations in connection with particular topics of nature-study. Such minor associations of nature-study lessons with manual training exercises will add to the interest in the nature-study, and I can see no reason for expecting another effect on the manual training.

Supplementary Note

In answer to a question raised in the discussion by my colleague Professor C. R. Richards, I here add to the paper as read the following note :

In all the foregoing, I have taken manual training in its literal and common interpretation as hand-work. However, we must bear in mind that under the influence of the most representative teachers this limited conception of manual training seems to be expanding and the term "industrial education" better describes the work now done in many schools where the shop-work gives manual dexterity and also the stimulation to study of the industrial relations of the materials used. In this broader conception of manual training there are numerous new possibilities for correlation with nature-study, for there may be close relation

in subject-matter, as well as in method as already indicated. I believe that the coming successful nature-study will have a decidedly industrial tendency in that it will deal largely with the every-day nature as it closely affects human life; and although we cannot now foresee just how the details will be worked out, it seems reasonable to believe that there must be developed a very close connection between what we may call industrial nature-study and industrial manual training.

THE SAP CURRENT: AN EXPERIMENT

BY F. L. STEVENS

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Few of the phenomena of plants are so little understood, or so much misunderstood, as that of the sap current. Since the time of Liebig there has been misconception as to the nature of respiration in plants, and respiration has been sadly confounded in the minds of many teachers and most pupils, and even in some reputable text-books, with carbon assimilation. This misconception is now giving way. Knowledge of the sap current, however, is not so rapidly becoming general.

If you will put the question, "What effect will girdling a branch, that is, removing all of the bark down to the wood, have?" to a class of pupils of any grade from the primary school to the university, the answer almost invariably will be that "those portions of the branch lying beyond the girdle will die." Your class will go even further and give an explanation for the assumed dying, by stating that the sap current which passes through the bark is interrupted and the water supply of the leaves cut off. Such an answer would also almost invariably be received if the question were put to a body of practical farmers or horticulturists, men accustomed to handling plants. Yet a more erroneous belief could hardly be imagined; for as a matter of fact, the branch beyond the girdled portion does not wilt under these conditions. The explanation offered for the supposed wilting is, of course, totally fallacious.

So sure is your class that wilting will occur, and so sure are they of the correctness of their explanation that an experiment upon this subject is particularly attractive. They are certain that they know what the results will be, and consider the experiment childishly simple, utterly useless. As the days go by, however, they find their predictions unfulfilled. Then their confidence changes to uncertainty and finally to wonder, and their minds enter upon a condition ex-

ceedingly receptive for a true conception of the facts. The experiment is readily made with pupils or people of any age anywhere. It is particularly striking in the spring time, although it is convincing at any time when there is foliage on the branches.

The accompanying illustration shows the steps of the experiment as conducted by one of my classes this year. The rose twig shown in Figure 1 has been girdled, that is, the bark has been removed, leaving the sap-wood bare. The length of the girdled belt is immaterial,—½ to ¾ of an inch is very good. Figure 2 shows the twig after girdling and

FIG. 1 FIG. 2 FIG. 3

Fig. 1 is a photograph of a girdled rose branch. In Fig. 2 the girdle is covered with wax. In Fig. 3 the stem is thickened (see the arrow) above the girdling, five weeks after girdling.

the wounds covered with grafting wax to prevent the sap-wood from drying up, and insects and fungi from interfering. Figure 3 shows a girdled and waxed twig five weeks after the twig had been girdled. The waxed and girdled place is to be noted on the lower part of the stem; the large mass of thrifty, healthy, unwilted foliage is seen above the girdled part. This experiment was particularly striking since the girdling was done soon after the buds were opened in the spring, that is, when the leaves were opening fastest, and the required supply of sap was consequently very great. The twig evidently (see Fig. 3) was not wilted, nor would it wilt in months or even years.

Your class is thus forced to conclude that the bark is not needed to conduct the sap to the parts above. The bark is removed, the wax obstructs the place previously occupied by the bark. The conclusion is inevitable that the upward current is in the wood with a bare possibility that some of it may rise through the pith. An examination of the pith, however, in most cases shows it to be entirely inadequate for water conduction. Further experiments could be made which would prove conclusively that the pith cannot conduct water at all. Thus we are left with the firm conclusion that the sap current rises through the wood and not through the bark.

Some of your pupils will now ask, "Why is it, then, that if we girdle a tree around its base, the tree dies?" This is a very different proposition from girdling a single branch on the tree. A full explanation of this phenomenon is too long for this present article. We may briefly explain it, however, by saying that there is a downward current of food material through the bark and that the roots receive their supply in this way. If the bark be removed at the base of a tree, the path of food from the leaves to the roots is blocked and the roots as a consequence sooner or later are starved to death. The death of the roots in this fashion of course ultimately brings about the death of the tree top. It will be seen from this, then, that in the experiment we have just outlined, the girdled branch is receiving its sap from the roots, but it is not sending back to the roots any food material whatever. A branch in this condition is partially a parasite upon the rest of the plant. It is receiving but it is giving nothing in return.

NATURE-STUDY IN CITY PRIMARY SCHOOLS

BY MARY C. DICKERSON

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Author of "Moths and Butterflies" and "The Frog Book"

[This paper contains the substance of an address before the Primary Teachers of Providence, Rhode Island.]

During the past few years there has been a great nature movement, and in many of the schools of the country nature-study has been given a place in the curriculum. But even where this has been done it is not always an honored place that nature-study holds on the program in the schools. This is because of very definite diffi-

culties: (1) the already over-crowded condition of the curriculum; (2) the lack of training on the part of teachers (because of the immensity of the subject and because the subject is so new that opportunities for studying it have not existed in any of the schools or colleges of the country); and (3) the difficulty and unusualness in teaching the subject because it deals not with books but with concrete living material—material that must be obtained! And as if this were not problem enough, it must in many cases be kept living in what would seem to be the most unnatural place for it, the schoolroom; or more unusual and impracticable still, there must be class field-work or gardening.

Let us consider for a few moments the claim that nature-study has to a place in public school work. If we find its claim well founded, we may expect that nature-study will eventually, even though slowly, force its way to a regular place beside other subjects; and we as teachers must in one way or another overcome the difficulties and problems that present themselves in this unusual kind of work.

Whether or not a given subject shall remain in the curriculum of the schools does not depend on the persons in authority who have put it there, nor on any boom which may make it a fad; but it will find lasting place in the school only if it rests upon a solid foundation in the need of the civilization of the time and promotes in a way impossible to other subjects the development and training of the child.

Does nature-study stand these tests?

The primary child has little or no power of logical thought, but he has keen senses, great muscular activity and strong feelings; therefore any school work that makes no great demand on the reason, but that tends to the natural use of the senses, encourages muscular activity, and above all furnishes a proper channel for a child's feelings is work especially fitted for primary grades. Certainly from this standpoint child-study and pedagogy make no mistake when they maintain that nature-study and manual training shall play a large part in the early education of a child, to the exclusion of work that appeals mainly to the reason.

We agree that nature-study appeals directly to and develops the senses. It brings about free use of the large muscles of the body because it gives an impluse towards out-of-door life, towards trips into the country and towards gardening. Further, nature-study gives pleasurable work; and of all characteristics in the world, primary-

school work should have the one of joyousness. Many of the children of our cities have none too much joy in their lives, and if happy are so in spite of circumstances; yet on the happiness or unhappiness of the child will depend very largely the nature of the man or woman.

Admit that nature-study tends to the natural and best development of the child. If this subject is to absorb any great amount of time in a school curriculum, its claim should be the need of the nation.

What are the facts?

All experience and biological law show that we are in a large measure the result of our environment. Then our question is—"What environment will best train citizens?" Let us take nature-study's method and observe the times and the resulting man in America.

But a short period ago our country consisted of scattered farms and villages set down in clearings in the great forest. Gradually men moved west but always to a wild unsettled country where there were dangers in the very forest or prairie, and where there was in the mere struggle for a livelihood close and hard contact with nature. There were but a few weeks or months of school during the year, and books alone were studied. However, the education of the boy—and of the girl too—contained more nature-study and manual training than anything else, but these were obtained in the work and play of the home. We know the kind of man that resulted from this training. Many of our leaders like Lincoln were examples, but all the host of men that made the nation had the same qualities in greater or less degree. They were earnest, self-reliant and high-minded.

The times have changed and very little of the old environment is left. Instead there is the crowded life in cities with their closely connected suburbs. The education of the future citizen is obtained in city homes (which often yield mere food and shelter), in city streets and places of amusement or of business, in the public schools and perhaps for the few in the college. New and greater opportunities are in the life, but surely there are greater dangers than ever came from forest or prairie, for they threatened the life of the individual while these may eventually threaten the life of the nation. Indeed it would seem that many of the city children of today might become the very opposites of their forefathers in regard to the qualities of earnestness, determination, self-reliance and high-mindedness.

What active influences can be brought into the education of the child to pull counter to the dangerous influences of city life? Turn

where we will we can think of nothing more powerful than contact with nature and active manual work. These influences can act with greater force in the homes ; but the impulse, the example and the information must come from the schools.

All this has to do with the character of the citizen. The nation must consider also industrial questions on which its welfare depends and it has a right to ask that the public schools shall aid in times of crises. The country has approached quite near enough to disaster in regard to the industries pertaining to agriculture and forestry. These industries are fundamental in a nation because they supply the necessities of ordinary living and give more employment than is furnished by any of the other industries. There has been great growth of cities and not a corresponding growth of farms, in fact there has been considerable abandonment of farms. The right proportion must be kept between the consumers in the cities and the workers on the farms of the country. The nation stands in great need today of more interested workers and improved methods in all the industries pertaining to the cultivation of our farm land and the management of our forests ; and this is the need not only of today, but it will continue to be a more and more threatening need as civilization advances.

Nature-study in the schools will tend not only toward keeping the life of the city child high-minded, but may lead him later to pursuits that grow out of interest in nature—may lead him into country life. Nature-study in the country schools will not only open the eyes of the children to the natural beauty about them, but will tend to increase their interest in farm life, to dignify and elevate the work of the individual farmer, and help him to get a larger return in dollars and cents.

After serious consideration from these fundamental standpoints it would really seem that nature-study has not only a rightful claim to a place in the public school curriculum, but also has a claim to a considerable space on the program.

If this is granted, then comes the difficulty ; for we have given ourselves lofty aims and are face to face with the problem how to attain these results.

Let us attack the problem—limiting our consideration to primary grades—" What shall primary nature-study teach, and how shall the results be gained ?"

First, we must understand from the circumstances of the case that

the primary grades cannot do all of nature-study. They can do nothing difficult or complex. They can accomplish very little relatively along the industrial side. We must relegate to the grammar grades detailed study of forests and their products; different kinds of wood and their use in manufactures; the fish, lobster and oyster industries; the large economic relations of birds, insects and plants; and the greater part of practical or scientific agriculture.

However, there are definite things that primary nature study can do and can do better than any other subject at any other time in the life of the child.

It can teach the children to know and to love the common nature objects, those objects that come so closely into the life of the country child who spends much time out-of-doors. If we were ever in the country when we were children, let us go back to that time. It is spring. We are walking along a path through fields and woods and perhaps along a brook. The house dog is with us and we stop to throw sticks and stones for him to bring back to us. We feel the warmth from the sun and the coolness of the breeze; but we do not think of these. We enter the woods; we know that there are trees only because they give shade and because we find nuts and leaves on the ground. We are conscious of little that is very large or very far away from us. But we are keenly conscious of the ground that we are so near—the ground with all its small things to be found and gathered, handled and carried home—and besides, other still more wonderful things, the low-flying birds and butterflies, and in the brook frogs and fish and turtles, very wonderful but perhaps less satisfying because so difficult to possess.

This gives us our clue as to what nature objects to use in primary grades. There should be some animal study—study of household pets and domestic animals, common birds, a few common insects, fish and frogs, toads and turtles; but the greater part of the work should be plant study—flowers, fruits, leaves, twigs and buds, and seeds.

And we are to teach little children to know and to love them. The first is relatively an easy matter, but in regard to the second we must proceed cautiously and criticise our methods and plans searchingly. For if the child has had any experience outside of the heart of the city, he probably knows these same objects or similar ones and there is already a glamour over them that it would be cruel to dim or take away. And if the child has always lived in the heart of a city

so that nature objects are almost or quite new to him, again we must beware, remembering that love of an object does not come into a child's heart so much from the beauty or wonder of the object as from association of this object with some loved person, or some place or time that gives pleasure. What in nature did we like when we were children? Objects that we see now, sometimes, when we look out beyond the horizon of our responsibilities and all-absorbing human interests, and that make us long for something of the child's power of building a world of contentment about the objects close at hand, whether beautiful or despised. Daisies for wreathes, dandelions for curls, burdocks for baskets, willows to be made into whips and whistles, nuts to be cracked and eaten, and as we recall the nuts there are beside them a host of delicacies, prominent among which are sorrel and "cheeses" [fruit of the common garden mallow.] The things that we liked were always things associated with our pleasures. We must remember this law of association in the primary grades or we shall find ourselves not only failing to make the children love nature but taking definite steps towards making them dislike it.

In actual life, as we have said, it is the child's curiosity, activity in play or his desire to satisfy his hunger that introduces him to nature; his information about it and love of it come later through the avenues of his senses. In a way this tells the teacher her method. Incidentally it suggests another thing, viz. that nature-study in *primary* grades must train the child's senses—not merely use them. Nature-study must make these senses act with larger and more accurate results.

When we give a primary nature lesson, let us have in mind the ideal lesson in which there is no behavior unfitted for the schoolroom, no child is thinking of anything but the material and the teacher, and yet there is the life and spontaneity inspired by the subject, the free handling of the material when necessary for the discovery of facts, and the enthusiastic expression of discoveries and feelings.

To get the best results from a given lesson is a problem that nature-study has in common with all other subjects. Its solution may be helped by changes in conditions as advance in education goes on (such as reducing the number of children in a schoolroom). At present the method of observation lessons is the individual teacher's problem and must depend on existing conditions and the personality of the teacher. One of the greatest aids is a definite directing of the observation—telling where to look, and what to look for, what to

do and how to do it, but never a suggestion of what is to be discovered.

But this is not all. Education in any grade demands that a child shall get more from a directed contact with nature than he ever could gain without direction even if he lived with nature. Education demands an understanding of the facts observed in so far as the mind of a child can grasp the meanings. The primary child has little power of reason, but even a first grade boy or girl can see relations by analogy with himself in important food and protection questions, and by analogy with various things more or less common in his experience. In this way he knows that the scales are a coat for the small green leaves of the horse-chestnut bud and that they keep out the rain and guard against changes in temperature all winter; that the tail of the gold-fish has the position and side movement of the rudder of a boat and so steers the fish.

Much work of this kind can be done in the third and fourth primary grades and in this way will be begun that action of the mind which if carried on will result in habits of investigation, independence and initiative. In these grades the children can be easily led to see the fitness of things even when it does not appeal directly to anything in their own experience. The corn seedling can push itself straight up through the hard soil because it is sharply pointed. The pointed pine tree can grow on mountains in more exposed situations than can the broad-topped elm because it has fewer branches and less bulk higher in the wind, and pine tree trunks make good masts for ships because they prove by the situation in which they lived that they are strong and flexible enough to endure the winds at sea. The toad is not supposed to be seen by many of its enemies because its color and markings make it look so greatly like the ground on which its lives. The swallows have such long and strong wings that they can fly for hours without resting; their mouths are unusually large, adapted to catch insects while flying.

Let us never fail in a lesson on any nature subject to give the children opportunity to think out relations of this sort Most people are satisfied to see that a thing is so, they do not ask, "Why is it so?" or "How is it so?" Inspire in the children in every way possible a spirit of inquiry. This is another work that nature-study can do better than any other primary subject. In addition to the mental training that results, the child gains an idea of the fitness of everything for its place in the world, an idea of the law and order in the

universe that no amount of mere observation of the facts would ever give and that is more important than the whole category of facts about nature.

But to go back to our most important aim in the primary nature-study; we cannot gain permanent results, we cannot make the child really know and love nature by even the most ideal of isolated observation lessons. There must be continued observation, companionship with growing, active plants and animals. It is what the child can do with the plant or animal or what the plant or animal does—it is action in one or the other, or best of all in both—that is most interesting to the child. This desire for activity is, when guided, our most valuable ally in teaching nature-study. For plants and animals are alive and active and are not only doing something all of the time but are doing such wonderful and unlooked for things that study of them is a fascination; and secondly, all of them bear more or less vital relations to man so that there is usually some profitable thing that the child can do with them.

How are we going to do anything of the sort in the schoolroom? Some of it very easily. Let the children study the activity of small fish, of the frog and the toad, and the turtle for two or more weeks at a time in the spring or fall. (These are kept with no difficulty in aquaria or small moss-houses). Let the children have common house-plants to take care of and watch grow, geraniums, begonias, fuchsias, etc. But best of all let them grow plants from seeds, all sorts of seeds but especially those that you know will come most closely into their experience and interest—flower seeds such as morning glories, nasturtiums and bachelor buttons; tree seeds, especially those of fruit trees and nut trees; and perhaps seeds of the common vegetables, peas, beans, corn and squash. Let the children plant them, take care of them and rear them to their flower or seed periods in many cases.

If practicable let them watch the development of the frog, salamander or toad eggs. Nothing in schoolroom nature-study can inspire more reverence for life than the continued thoughtful watching of the growing seed of flower or tree or the developing egg of the frog.

We see that something can be done in the continuous observation of plants and animals in the schoolroom, but there is so much of this observation that cannot be done because of existing conditions that if the work stops here, nature-study falls very far short of doing its full work. The school must begin the work and set the example with such enthusiasm and force that the impulse will be carried out and beyond into the home.

Let the children start slips from the plants at school to be taken home when rooted. Let them plant morning glory and other flower seeds to be transplanted to home gardens, or, if there is no home garden, to small garden spots that can be made at home beside the fence or porch or under a window. Let them plant tree seeds in flower pots or boxes in the schoolroom, take care of the little seedlings until May or June and then transplant them to the home yard or possibly to the school-yard. As Dr. Hodge suggests, give them in March seeds of rapidly growing plants (such as the nasturtium that will bloom before the close of school in June. Let these be planted in flower pots or boxes at home and cared for by the children and brought to school for a flower show in June.

If possible have a school-garden, even if it is extremely small and is owned by the whole school together. If the work of the garden is done by the children, its influence will extend into some of the homes of the children of the third and fourth grades if not into those of the younger children. A garden (his own garden) is more all-absorbing to a child of seven or eight than are mud pies to a child of five. Have talks about gardening, keep the florists' gaily-illustrated catalogues in the rooms, they will prove quite as interesting and suggestive as some of the supplementary readers.

In the study of twigs and buds in the third or fourth primary grades, root twigs of poplar and willow and transplant the resulting young trees to out-of-school places where they can be taken care of by the children.

If practicable have various pets belonging to the children in the schoolroom for a day or more for study—a canary, pigeon, squirrel or rabbit, etc. Assign home observation of the children's pets and of the domestic animals which the children see. Discuss with them the best care for each of the animals dependent on man's kindness. Encourage the children in keeping pets and in giving them their best care.

These suggest some of the practical ways in which nature-study may extend its influence beyond the school and obtain the coöperation of the parents in the work.

And this is not all. If nature-study stops here it falls short of the aim set. Nature-study must make the child know the country. It seems pathetic that a big Italian girl in a city no larger than Providence should have been able to say to the teacher: "I never knew about the country. If you will tell me where it is I can get my father to take me there Sunday."

The primary boy or girl must know not merely the isolated wild flower and pussy-willow twig, the plants growing in pots and boxes in the schoolroom, his own small garden in his back yard and the trees of the city streets, he must know nature's great and glorious garden, the country. He must know the fields where the daisies grow and the bobolinks sing; the brook that winds through the meadow between borders of willows and alders where the redwings nest,—the brook that is a home for frogs and fish and a bathing place for tanagers and all manner of birds; the woods low and dense and almost impenetrable, or high and open with a carpet of wild flowers and ferns, where the drumming of the woodpecker can be heard.

The country presents nature in her own environment, and this is what the child must know. After a trip to the country he can go back to his schoolroom nature objects with new interest and new understanding. The country makes a profound impression on the city child who seldom sees it. What he saw and did fills very many of his waking and sleeping hours and he looks forward with keen anticipation to "going again to the country." He does not see the beauty of the extended landscape, the harmony of blended coloring, the distant line of woods against the sky; he is too young to see and understand the great struggle for existence that is going on all around him, but with his alert senses, he will see or hear and find more flowers, nuts, frogs, bird-nests, etc., than we could find in twice the time.

How can nature-study in the schools introduce the child to the country? In a suburban school the matter presents no problem, but in a school near the heart of the city the question becomes most difficult. The present solution in a city of moderate size is that occasionally field trips shall be taken by utilizing the shortest street-car routes to the country. On these expeditions the teacher should be still the teacher. The practicability of field trips varies greatly. Some teachers can take large classes successfully, the possibility of doing so depending partly on themselves and partly on the class in question. However, in the majority of cases, it is best to take a small number of children, twelve being about as many as can be handled with the best results.

There are a few important points to consider in order that the field work in primary grades shall be most successful: (1) The teacher should know in advance the locality to be visited and what things are to be discovered. (2) She should have in mind a well-defined aim

or aims for the trip just as she would have for any school lesson. (3) On the trip the teacher's whole thought should be with the children, seeing nature from their standpoint as much as possible, and the children's whole attention should be with the teacher. All should see, hear and talk about things together, there should be no division of forces whatever. (4) The teacher must remember the activity of the children and supply proper channels for it.

This then is what primary nature-study can do for city children. It can develop the senses and start that habit of mind which looks for and thinks out relations. It can give them a love of the beautiful in nature and a respect and care for the helpless. It can give such a strong immediate interest in plant and animal life that the child not only will be led to beautify his home, but will spend a part at least of his Saturdays and time after school in his home garden or with his pets or in trips to the fields and woods. The ways in which these results can be obtained have been in part suggested. It must be added that there must be concerted action and continuous effort throughout the months of the year and the years of the primary school.

What sort of teacher can handle nature-study in the limited time allowed in a crowded curriculum so as to bring about these results? The one thing essential—for the spirit in primary nature-study is everything—is that she herself should have felt the influence of nature. She must at some time in her life have felt sympathy not only with man but with all life. She must have felt the quiet beauty of the blue flags in the marsh; have been uplifted by the purity of the woodthrush's song; or have been filled with reverence that the power we call life can change the tiny, dry seed into hundreds of gay flowers and green leaves. She must realize that nature is man's friend, not his enemy. She must be eager to learn, as advances in science and civilization go on, the details concerning man's best attitude toward nature, the attitude that will allow man to control and use, yet not destroy. Such a teacher, a lover of nature and a lover of humanity (she should be the latter or she should not be teaching children at all), can have so much influence for the immediate good and for the future happiness of the children under her charge, that we stand in awe before the majesty of her work. The primary teacher in city schools has it in her power to become one of the greatest forces of modern times, shaping for good the destinies not only of individuals but of the nation and the race.

GALLS AND GALL-FLIES

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Familiar to all children who have an opportunity to see trees and plants out-of-doors, and familiar to all teachers interested in nature-study, are the deforming galls which occur on oaks, willows and roses, and on some herbaceous plants. These galls and the insects which live in them can be readily got acquainted with by some little work and observation, and their study offers an excellent chance for some interesting nature-study lessons. The following account, which may serve as a sort of guiding introduction to these galls and gall-flies, is based upon my recently-issued "American Insects," which is probably not accessible to most readers of this magazine.

Indications of the work of certain hymenopterous insects are familiar to even the most casual observers in the variously shaped "galls" that occur on many kinds of trees and smaller plants, especially abundant on oaks and rose-bushes. Not all galls on plants are produced by insects, certain kinds of fungi giving rise to gall-like malformations on plants, nor are all the insect-galls produced by members of that family of small hymenopterous insects called the Cynipidæ, or gall-flies. But most of the closed plant-galls and particularly those conspicuous, variously shaped, and most familiar ones found abundantly on oak-trees and rose-bushes, are abnormal growths due to the irritation of the plant-tissue by the minute larvæ of the Cynipid gall-flies. These flies are all very small, the largest species not being more than one-third inch long; they are short-bodied and have in most cases four clear wings with few veins. The females—and in numerous species there seem to be no males—have a long, slender, and flexible but strong, sharp-pointed ovipositor (see illustration), composed of several needle— or awl-like pieces, which is used to prick (pierce) the soft tissue of leaf or tender twig so that an egg may be deposited in this succulent growing plant-tissue.

Each female thus inserts into leaves or twigs many eggs, perhaps but two or three in one leaf or stem if the galls are going to be large ones, or perhaps a score or so if the galls will be so small as to draw but little on the plant-stores and be capable of crowding. In two or three weeks the egg gives birth to a tiny footless maggot-like white larva which feeds without doubt largely through the skin, on the sap abundantly flowing to the growing tissue in which it lies.

A gall-fly much magnified.

Galls made by a cynipid gall-fly, natural size.

Ovipositor of a gall-fly, dorsal and lateral views. The long spine is the organ used to pierce the leaf or twig. This and above figures are from Kellogg's "American Insects," by courtesy of Henry Holt & Co., New York.

With the birth of the larva begins the development of the gall, which is an abnormal or hypertrophied growth of tissue about the point at which the larva lies. The excitation or stimulus for the growth undoubtedly comes from the larva and probably consists of irritation by special salivary excretions and perhaps also of physical irritation caused by the presence of a wriggling body. In some species the gall grows around and includes but a single larva, in others around several to many. The larva reaches its full development about coincidently with the full growth or end of the vitality of the gall, this period varying much with different galls. In the galls on deciduous leaves the vitality is shortest, ending in autumn ; in twig-galls it may not end until winter or even until the following or indeed the second winter. When "dead" the gall dries and hardens, thus forming a firm protecting chamber in which the larva or larvae pupate. The pupa undergoes its non-food-taking life securely housed in the dry gall, which may fall with the autumn leaves or cling to the bare twigs. From the galls the fully developed flies gnaw their way out when new leaves and tender shoots are appearing, ready to prick in new eggs for another life cycle.

But strange to say, with some species the new eggs may be deposited on plants of another kind and the hatching larvae stimulate the growth of entirely different-shaped galls, and they themselves develop into gall-flies of marked different appearance from their mothers. These new gall flies in their turn lay eggs on the first host-plant ; the forming galls are like those of the grandparent generation and the fully developed flies are of the grandparent kind. This alternation of generations—a condition in which a single species appears in two forms and produces two kinds of galls, usually on different host-plants—has been long known, but still remains a problem which interferes sadly with a number of popular biological generalizations. One of these generations appears exclusively in only one sex, the female, so that the other generation, composed of both males and females, is produced uniformly from unfertilized eggs. The adults and galls of the two generations were formerly described as belonging to different Cynipid species. Not all gall-flies, however, show this dimorphic condition ; some appear habitually in but one form and produce but one kind of gall ; in most if not all of these cases the species is represented only by female individuals.

The great variety of the galls, the extraordinary instinct which leads the adult flies to the right selection of plant and position on

twig or leaf for oviposition, and the interesting response or reaction of the plant to the growth-stimulating irritation of the gall-fly larva are subjects which have attracted much attention and study, but concerning these much remains to be discovered. In size and shape the galls present amazing variety; some are irregular little swellings on the leaves, others are like small trumpets, others like rosettes, or star-like with radiating points; on the twigs some are spherical, some elongate, and some large and reniform. In their interior make-up they also differ much; some have a large hollow central space; some are filled with open spongy tissue, and some are solid except for the cells and tunnels of the larvæ. In some but a single larva lives; in others are three or four or a dozen. Externally some are smooth, some roughened, some hairy. They occur on leaves, branches, and roots in both oak and rose. Only a few Cynipid galls are known on other plants than these. In the face of the host of species of Cynipidæ found in this country—over 200 gall-making kinds are known, besides a score of parasitic species—and their small size and generally similar appearance, we shall not undertake to describe any of the various species.

Regarding the wonderful instinct of the gall-fly, I quote the following from Stratton, an English student of galls:

"It is impossible that intelligence or memory can be of any use in guiding the Cynipidæ; no Cynips ever sees its young, and none ever pricks buds a second season, or lives to know the results that follow the act. Natural selection alone has preserved an impulse which is released by seasonally recurring feelings, sights, or smells, and by the simultaneous ripening of the eggs within the fly. These set the whole physiological apparatus in motion, and secure the insertion of eggs at the right time and in the right place. The number of eggs placed is instinctively proportionate to the space suitable for oviposition, to the size of the fully grown galls, and to the food-supplies available for their nutrition." Certain species will only place from one to six eggs on a leaf which other species would probably prick a hundred times.

The exact character of the plant's abnormal growth has been recently studied by several investigators. Cook, an American student, concludes from his studies that in the formation of all leaf-galls (except the cecidomyid or dipterous midge-galls) the normal cell-structure of the leaf is first modified by the formation of a large number of small, compact, irregular-shaped cells. The mesophyll is

subject to the greatest modification and many small fibro-vascular bundles form in this modified mesophyll. Both Adler and Sockeu consider that after the first stages of formation the gall becomes an independent organism growing upon the host-plant. Cook believes this to be true of the Cynipid galls. A surprising conclusion arrived at by Cook is that the morphological character of the gall depends upon the genus of the insect producing it rather than upon the plant on which it is produced; *i. e.*, galls produced by insects of a particular genus show great similarity of structure even though on plants widely separated; while galls on a particular genus of plants and produced by insects of different genera show great differences. The formation of the gall is probably an effort on the part of the plant to protect itself from an injury which is not sufficient to cause death.

An additional interesting feature in the economy of Cynipid life is the presence in the galls of other insects besides the gall-makers. These others are on two footings, that is, some are guests or commensals, and some are true parasites, either on the gall-makers or on the guests. Curiously, among both guests and parasites are members of the same family, Cynipidæ, to which the makers and rightful owners of the galls belong. Others of the parasites may belong to the various well-known parasitic hymenopterous families, as the Ichneumonidæ, etc., while others of the commensals may belong to entirely distinct orders, as the Coleoptera [beetles], Lepidoptera [butterflies], etc. Kieffer (a famous French student of galls and gall-flies) gives the following amazingly large list of commensals and parasites bred from a common root-gall on oak. Commensals, the larvae of five species of moths, of one fly, of one beetle, of one Neuropteron, and of two Cynipids; parasites, a total of 41 species, bred mostly from the various commensals.

The guest gall-flies, called iniquilines, are often surprisingly similar to the species which actually produces the gall. A similar likeness between host and guest exists in the case of the bumble-bee (Bombus) and its guest Psithyrus (closely related to Bombus). It may be that the guest species is a degenerate loafing scion of the working stock.

The group of gall-flies and their allies is looked on as a superfamily, the Cynipoidæ, in the latest authoritative classification (Ashmead) of the Hymenoptera, and divided into sub-families, the Cynipoidæ including the gall-makers, and the much smaller family,

Figitidæ, including the parasitic species. Only about a score of parasitic Cynipoids are yet known in this country, while over 200 gall-making species and guest species are known.

To collect gall-flies the galls should be gathered especially in the autumn, for with the end of the growing season the larvæ are mostly full grown and ready to pupate. They should be separated according to kind, those of each kind being put into small closed bags of fine-meshed bobinet or tarlatan. In these the various gall-flies, iniquilines, commensals of other orders, and the parasites will issue, and may be thus identified with their proper gall.

NATURE NOTES

Telephone Poles and Forestry. According to the Forest Service, there are in the United States 800,000 miles of telephone and telegraph lines, requiring 32,000,000 poles; and these must be renewed approximately four times before trees suitable to take their place can be grown. A pole lasts in the service about twelve years, on the average, but is made from a tree about sixty years old. In other words, to maintain a continuous supply five times as many trees must be growing in the forest as there are poles in use. The severity of this drain upon forest resources by the telephone and telegraph companies is obvious enough. Experiments to test effect of proper seasoning and certain preservatives are being made.

Coyotes. Bulletin No. 20 of the Biological Survey, U. S. Department of Agriculture, deals with the small prairie wolves of the western and south western parts of North America which are commonly known by the Spanish name "coyote." They are abundant in spite of the advancing civilization which has driven so many wild animals from the western plains. Last year Kansas paid bounty on 20,000 scalps at $1 each. The animals feed on many animals, destroying farm animals, game birds, deer and antelope, and even jack-rabbits. The swifter of the game animals are run down by packs of coyotes. Among farm animals killed are named chickens, turkeys, cats, young colts, calves, pigs, lambs, goats, and occasionally full grown cattle and pigs. They are the most destructive enemies of sheep. The coyotes are wary and not easily poisoned or trapped. The most successful and at the same time most expensive remedy is fencing them out with wire-netting, which costs $300 to $500 per mile. One sheep ranch of 4,000 acres in California has been fenced.

Spiders' Webs. To preserve for museum purposes spray with artist's shellac, using a simple tube atomizer. Then press a clean glass plate against the strands, which will stick, and carefully break the supporting threads. When the shellac is dry another glass plate may be used as a cover and the edges protected with gummed paper as in lantern slides. (F. E. Lutz, in *Science*, Vol. 23, March 9, 1906).

Incubation of the Emperor Penguin. The breeding habits of this bird, the largest of the penguins, were observed by naturalists on the *Discovery* which returned from the Antarctic to England, in September, 1904. Each hen lays one large egg; and a very remarkable fact is that the hen standing in the characteristic upright position on the sea-ice holds the incubating egg on the feet, covered with the dense feathers of the abdomen, and

away from contact with the ice. The hatching occurs in seven weeks, in the coldest month (August), with recorded temperature as low as 60° below zero Fahrenheit. The great majority die, largely because the adults quarrel over the chickens. (G A. Wilson, *Nature*, 73:211. Dec. 28, '05).

The Dugong. The January number of the *American Naturalist* has an account of recent studies of this interesting sirenian, which is closely related to the manatee (sea-cow). The low flat coast of East Australia is one of the favorite haunts of the animals, which feed on various sea "grasses" growing on the bottom of the shallow bays. It is not known to live in brackish waters at mouths of rivers, but it remains in the outer ocean during the day and at night enters the bays to feed. Being a lung-breather (mammal) it must regularly come to the surface for air.

Pelican Reservation. The great brown pelican, formerly abundant but now rare, is still found on islands in the Indian river 200 miles below Jacksonville, Florida. One of the islands is now a Government reservation and a resident warden has put an end to the former butchering. An interesting point relating to habits is that the pouch is said not to carry fish to the young in the nest, as is popularly believed. These and other notes on habits are given by C. F. Wolf in the February *Shield's Magazine*.

Flying-Fish. C. D. Durnford, writing in the January *American Naturalist*, takes up the old controversy as to whether flying-fish do or do not flap their wings in flight. His own observations and mechanical considerations (such as the size of wings) lead to the conclusion that the common flight is due to rapid wing movement, and is not sailing like an aeroplane. Contrary to a common opinion, the fish are said to have power of steering in flight.

Fossil Insects. Near Florissant, in Colorado, fossil insects are very abundant, over 500 species having been found preserved in the fine mud and sand deposited during Tertiary times. (T. D. A. Cockerell, in *Entom. News*, Jan., 1906.)

Introduction of Bees to Australia. Indigenous honey-producing floræ abound both on the continent of America and in Australia, yet it is a singular fact that the most diligent search of the entomologist and other naturalists failed to discover any social honey bee having a commercial value. Certainly there is a bee of the genus Apis indigenous in America, but the hive-bee was an introduction.

In Australia, the greatest honey insect is the so-called native bee. Trigona carbonaria. The native bee of America belongs to the family Melipoma, and does not occur elsewhere, but the bee Trigona is found in Africa and

India, as well as through Australia. The honey gathered by these native bees is variable in quality, but never equal to that of the hive-bee.

It is not so very long ago, however, since "wild" honey was much sought after in our Australian bush as one of the greatest of luxuries. The fact that the Trigona has no sting induced many people—who would, in those days of crude, ruthless methods, have shrunk from an adventure with social honey-bees—to wage war against the stores of the "native bee." In 1822 the first hive-bees were brought to this part of the world, and from the bees thus introduced colonies were propagated and distributed inland among the colonists. The descendants of these bees soon spread themselves fairly well over New South Wales. Of course these bees were kept in hives or boxes of any or every shape or style. The bar-frame hive was then unknown. Under the old system anyone could have bees who had the courage to rob them. The stray or escaped swarm of bees took to the bush. The aborigi-nals soon learned from their white brothers how to subdue bees by means of smoke, and with tomahawk and firestick, aided by strong vines, would ascend the loftiest and smoothest of trees to obtain the "white-fellow's sugar bag." The aboriginals have no word in their own language for the introduced bee. The flavor of the honey from the little native bee was no stranger to them, but they were not long in discovering that both in quality and quantity "white-fellow's sugar-bag" was far superior.

In the early seventies, so plentiful had bees become in the bush that in the markets, dishes and buckets full of honey, mixed with dead and dying bees, dead larvæ in all stages, broken comb, and rotten wood, were exposed for sale under the cognomen of bush honey. To look at it was anything but appetising. Better samples were bottled and sold under the name of "prime garden honey."

About 1872, our bees met with an enemy that bid fair to almost exterminate them—the bee moth put in an appearance, from whence we know not. Hitherto no skill was required in the management of bees that were kept at that time. New swarms were put into a piece of a hollow log, sawn off evenly at both ends, with pieces of stringy-bark nailed over the openings, and the bees had to obtain ingress or egress as best they could. Gin cases, tea chests, or boxes of other descriptions, were preferred, but in the bush at that time these were not always to be obtained. Manipulation of these hives was as crude as the grotesquely-made hives. There was no consideration given for the lives of the bees. These early bee-keepers knew little or noth-ing of the importance of the queen bee; they did not understand "no queen, no bees," therefore no honey. It was a general destruction. When the bees were robbed, wax, brood, comb, and queen were all sacrificed for the

honey, and the waste of the latter was almost as great in quantity as that obtained. This slovenly way of bee-keeping, combined with the ravages of the bee moth, would have set a limit to the days of bee-keeping in this country had not means been devised to check it.

Under the foregoing adverse circumstances thinking men looked around for something that would be the salvation of the bees. It was long believed that the Ligurian or Italian bee was an insect far superior in many ways to the English bee. Not only was it superior as a honey-gatherer, but it was reported to be far more alert, and more persevering in resisting the attacks of enemies, more especially the bee-moth which in England is known as the wax-moth. So great was the onslaught with these moth pests that people owning as many as 200 colonies in a few years found themselves without a single bee. How to contend against this pest was then unknown. The bar-frame style of hive was little known, and the method of fighting the moth in the gin-case hives was an unknown quantity; and so it remains to this day. Not only were the bees that were kept in the crude methods of the day decimated by this pest, but those that had taken to bush life suffered, perhaps, to a greater extent than those more immediately under the control of man. On the Clarence River, to my knowledge, in the latter part of the sixties, it was not unusual for men to take a horse and dray and go in search of bees' nests, returning with two or three hundred nests in the same tree. But in later years these, through the ravages of the bee moth have nearly all disappeared. From the general slaughter among the bees caused by the pest named, some few bee-keepers, with more watchfulness than others, saved a few colonies out of the general wreck. To perpetuate and multiply these was the question of questions. The Italian bee was looked to for overcoming the trouble caused by the bee-moth, and enthusiastic bee-keepers were not long in importing the far-famed golden and dull brown colored Italian bees. (Excerpt from *Agricultural Gazette of N. S. W.*)

Cultivating the Fringed Gentian. For years horticulturists have been trying to grow in gardens this splendid wild flower, but success has been very limited. According to an article in the December *Garden Magazine*, Mr. Thomas Murray, a horticulturist at Tuxedo Park, N. Y., has succeeded in growing numerous specimens. His method is given in great detail; in essentials he germinates the seeds on finely broken sphagnum moss, covering only with a newspaper to prevent rapid drying out.

Among many interesting points we note: (1) It is not an annual, as the books say, but a biennial. The seeds ripened in the fall of 1905 will make a little rosette of leaves in 1906 and the bloom will come in 1907. (2) It

often "changes its haunt" in the woods, because pods are often frost-bitten in middle September and seeds do not ripen. Mr. Murray writes that there will be few gentians at Tuxedo next year (1906) because there were few seedlings in summer, 1905, this owing to frost in middle September, 1904. (3) The reason why flowering plants set in our gardens have failed is that they were at the end of the life cycle and died after flowering. We should set seedlings for bloom the next year.

Guinea Fowl. Farmer's Bulletin 234 (free) urges the importance of this domesticated bird. The name is supposed to indicate their origin on the west coast of Africa. The Greeks and Romans raised them for the table, but they disappeared from Europe during the dark ages. In several islands, Jamaica, Cape Verde and others, the birds have reverted to the wild state. In England also they are game birds in the great preserves. They are raised for market in France and Germany and in several parts of the United States. The demand is rapidly increasing in our large cities.

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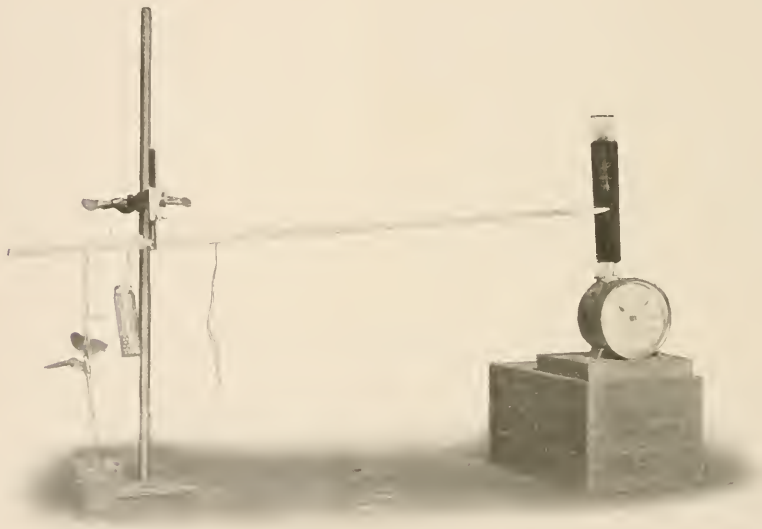

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April, 1906

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CONTENTS

	PAGE
Training Teachers of Nature-Study. A Series of Reports from Normal Schools and Colleges	121
Devices for Observation in Nature-Study. Illustrated D. R. WOOD	135
Macdonald School Gardens of Canada	140
Nature-Study and Gardening for Indian Schools	141
Bird Study for Fifth Grade. L. B. UNDERHILL	143
Notes on New Books and Pamphlets	147
Nature Notes	150
News Notes	152

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To Readers of The Nature-Study Review

(1). This April number is only slightly behind time and the May number may be expected later in that month. The postoffice technicalities which delayed mailing the February and March numbers are now satisfactorily arranged. Beginning with the September number, our printer will issue THE REVIEW in the first week of each month.

(2). The 1906 volume will contain at least 360 pages, from 32 to 48 pages in each issue.

(3). Please remember that THE REVIEW is *not a journal for beginners* in nature-study; but it aims to be for nature-study what *Science* and similar journals are for science, namely, a journal for the publication of the latest ideas of the best workers. If you have worked out some new point in theory, method, or subject-matter of nature-study, it belongs in THE REVIEW. Let us have your best ideas for publication. It appears from examination of the mailing lists that THE REVIEW now goes to all American educators and scientific men who are commonly known to be seriously interested in nature-study. Therefore, in no other journal will your ideas concerning nature-study reach directly so many people whose opinion you value. By contributing to THE REVIEW you will best help the great movement for which it stands.

THE
NATURE-STUDY REVIEW

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

VOL. 2 APRIL, 1906 NO. 4

TRAINING TEACHERS OF NATURE-STUDY

A Series of Reports from many Normal Schools and Colleges

It is universally recognized now that the future development of nature-study depends upon special preparation of teachers. In the early days of nature-study in any locality it may be very unorganized and informal, but sooner or later there comes a time when local educators inquire seriously whether nature-study is successful. You know the result—nature-study has in many cases been dropped from the program of schools. The cause of this is usually stated to be the inability of average teachers to handle nature-study. This is a quite satisfactory explanation to any one who has visited many schools and noted that most commonly nature-study is being taught either by teachers lacking both knowledge and interest, or by teachers having interest and enthusiasm but without knowledge of subject-matter and methods needed if critical observers are to be convinced that nature-study is worthy of an established place in the school program. Nature-study can no longer safely be left to teachers who depend upon "loving" nature instead of upon a thorough training in subject-matter and methods. It is therefore important that training schools study more carefully the problem of preparing teachers for efficient work in nature-study. As a contribution to later comparative summary of present practices in American training schools we present this month a series of brief reports from various institutions. Other schools which are known to be doing work in this line have not yet replied to circular letters and to the request in the editorial notes in the January issue. We hope to receive more reports in time for the September issue, which will be printed early in August.

No plan for order has been observed in arranging the following reports, except that normal schools are first and a few colleges last.

M. A. B.

PHILADELPHIA NORMAL SCHOOL FOR GIRLS

Ninety per cent of the students are high school graduates who have devoted four hours a week for one year to the study of botany and four hours a week of the following year to the study of zoology. Experience has shown us that the three things most obviously lacking in the entering students are: (a) a point of view, (b) contact with nature (c) teaching ability, especially in selecting suitable subjects and in so presenting them as to gain at once the interest of the children and to enlist their energies, either mental, or bodily, or both, in solution of resulting problems.

Therefore in our course of study we lay the greatest emphasis on: (a) evolution, both organic and social, (b) field work, (c) preparation of lessons under careful guidance and the teaching of them to classes of children under observation and criticism.

The time is distributed as follows: Courses in zoölogy, botany, and evolution in Junior Year and Teaching in the Senior Year.

Zoology. Two hours per week for half the year, field work and laboratory work: insects, birds, the aquarium.

Botany. Two hours per week for half the year, field and laboratory work.

Evolution. One lecture per week for half a year.

Teaching under observation, one hour per week.

As indicated above, the work in zoölogy is based on the results of observations made in field excursions. The specimens collected are classified in the laboratory, and their habits and life-histories studied. Each student is provided with a simple vivarium (a lamp chimney) in which insects, usually caterpillars, may be observed. Colored sketches of insects are made and their observations on them are recorded in note-books.

Topics relating to the materials obtained on excursions are assigned to individual students. With the aid of specimens, charts, and models they demonstrate the subject to their fellow students, and the matter and manner of presentation are then criticised by the teacher and the class.

Some time is also devoted to the study of common insects having economic importance.

Additional excursions are taken for the purpose of learning the appearance, habits, and songs of our common birds; and this study is supplemented by the use of stuffed birds, nests, and pictures, reference to books and pamphlets.

The work in botany is based on the material collected on excursions, on observations made at the same time, and on observations

made of required home work in the forcing of bulbs and the growing of at least five seeds. Drawings, color sketches, and written observations as well as the specimens themselves are brought to the laboratory and form the basis of the lessons.

By these means the students acquire more or less knowledge of the following subjects: Fruits, germination, bulbs, common plant families, the common names of some eighty or ninety common flowering plants, the common names of some twenty trees, some knowledge of half a dozen ferns, a moss, several mushrooms, bread-mold and other fungi, several algae, bacteria, winterbuds, folding and color of new leaves, pollination, parasitism.

In beginning the course in evolution we ask them to put on paper their ideas on the subject. Every year we find that 99 per cent of them believe either that evolution is a religious theory, or rather an irreligious one, or else that its cardinal tenet is that man has descended from monkeys. The others usually believe that evolution teaches that everything in the organic world harks back to an amoeba. We do not hesitate to supplement the study of organic evolution with such subjects as the evolution of art in Netherlands, or even the evolution of modern dress.

The students in their senior year have the same opportunity to teach nature-study under observation and criticism that they have to teach any other subject. In addition to this, provision is made for an extra hour per week spent in teaching a grade, or in observation, either in teaching a fellow student, or of the normal school teacher in the same grade. These lessons are usually a half hour long, so that there is time at their close for informal criticism both by the members of the senior class and by the normal school specialist, of the lesson just observed, and also for discussion of the next lesson.

L. L. W. Wilson

STATE NORMAL SCHOOL, HYANNIS, MASS.

Biology is required of all students throughout the two years course. An additional year is also given in the advanced class. In the first year botany is given 80 periods from Sept. to Dec., and from April to July, and zoölogy 80 periods from Dec. to April. In the second year anatomy, physiology and hygiene is given 80 periods from Sept. to Feb. Also in this year, there is practice in the Training School in nature-study or hygiene; one and one-half to two hours weekly from Feb. to July.

In the third year (advanced class) the students may take Advanced Biology: 280 periods from Sept. to June and extended practice in teaching in the Training School.

Botany. The course includes, from Sept. to Dec., a study of the fall flowers, plant families, plant societies, leaves, trees and forests, fruits and cryptogams; from April to June, buds, stems, roots, germination, gardening, spring flowers, plant families and methods in teaching plants.

Zoology. This course includes a systematic study of animals from the amoeba to man, and subjects like the distribution of animals and evolution. The nature calendar and bird walks help in the study of nature in the spring. The teaching of animals in the elementary schools is also studied.

Anatomy, Physiology and Hygiene. The foundation of the course is laid in laboratory exercises in the structure of the muscles of chicken, the brain of sheep, the eye of the ox, the chemistry of foods, etc. The hygiene is taught by supplementary reading and lectures.

Advanced Biology. This course consists of a detailed study of insects, the frog, a fish, as the cod, and a bird, as the pigeon. The detailed study of the distribution of animals and the history of biology give a broad scope of the subject of biology.

BERTHA M. BROWN.

STATE NORMAL SCHOOL, BRIDGEWATER, MASS.

The preparation of teachers of nature-study proceeds along three lines—laboratory study, field lessons, and classroom exercises with children. Its purpose is not only to cover the specific material to be used in the grades but to so broaden the view of the subject that the simple work done by the children will be seen in its relation to the whole science study of the schools. Laboratory courses form the preliminary step in the preparation.

The course in **Botany** includes: (*a*) general view of the plant world: (*b*) special topics used in nature-study, flowering and flowerless plants, relation of insects to flowers, common trees and their value, germination processes, the useful plant families, plant societies, dispersal of seeds, needs of plants, gardening, etc. The required work occupies forty hours. Elective lines are open to continue the studies.

The course in **Zoology** includes: (*a*) a general view of the animal world; (*b*) special studies of common mammals, bird families, useful and harmful insects, water life, development and metamorphosis, adaptation to environment; vivarium and aquarium preparation and study. The required and elective work is the same as in botany.

Mineralogy. A first-hand knowledge of the common minerals and rocks, for recognition purposes, to understand qualities of matter, used in the industries, study of soils and building stones. Forty hours and electives.

Elementary Geography All the topics that are usually needed in nature-study relating to air, water, soil, etc., etc.

Drawing. Practice in all the phases of drawing, sketching, painting, and modelling of natural objects which are used in connection with nature-study. A direct preparation is made for typical objects.

Literature. Selection of appropriate nature myths, writings of the best naturalists, acquaintance with the reference books of science.

Field Lessons. These are limited mainly to the autumn and spring terms. They are conducted frequently for purposes of recognition, for observing things in their natural environment, for understanding habits and the processes of nature, to prepare students to go out into nature themselves. Field books are required to be filled out with care and considerable fullness. Nature diaries are filled in by the students in preparation for similar work with children.

Class Work with Children. This consists of conducting exercises in all the different phases of the subject from the primary grades to the laboratory work of the older children in minerals, elementary physics, and the chemistry of common life. Blackboard sketching, nature calendars and diaries, assisting in field lessons and other lines of the work required in classrooms. This training work is associated with the regular practice so as to see nature work in its close coördination with the other subjects of the curriculum.

A. C. Boyden.

NORTHERN STATE NORMAL SCHOOL, MARQUETTE, MICH.

In the Department of Natural Science, under Professor E. R. Downing, there are twelve-week courses in human physiology, animal morphology, animal bionomics (habits, life-histories, distribution), plant morphology, and plant ecology. With special reference to nature-study there is the following course:

Nature-Study. Eighteen weeks. Fall, Winter and Spring terms.

This course aims to prepare teachers for the nature work in the grades. Those plants and animals are studied that are commonly suggested for work in elementary schools. Aims of nature work are discussed and citations made of the interesting available literature regarding forms studied and their relatives. Frequent field trips are made to learn to recognize common plants and animals, to study their life-histories and to demonstrate methods that may be used in field trips with the children. The course continues throughout the year, twice each week.

The Department of Physical Science offers courses in chemistry and physics, but the Announcement makes no mention of special adaptation to physical nature-study.

WASHINGTON STATE NORMAL SCHOOL, ELLENSBURG, WASH.

Under the direction of Professor Munson, a nine weeks' course in "descriptive botany" of flowering plants; a nine weeks' course in "systematic botany, plant analysis" with some ecology; and two similar courses in zoology are valuable for nature-study teachers. In addition, the following courses deal directly with nature-study:

Nature-Study and Agriculture. Eighteen weeks. Laboratory work, field work and readings. Scientific methods are used in the study of the familiar things of the farm. The course is intended especially for those students who are candidates for the elementary certificate. The student is expected to acquire such a habit of looking at things as will make him able to manipulate, to judge, to know and to appreciate things not only for their money value, but for their scientific, moral, educational and intrinsic value.

Nature-Study (Plants and Animals). Nine weeks. Field work, laboratory original observations with written reports. The course is intended to make the student familiar with the method and the matter suited for nature work in the elementary schools. The student is expected to do the work as he should require his own pupils to do it when he undertakes to teach the subject, more now being demanded of him by way of independent laboratory work and familiarity with library sources of information and general literature properly introduced in connection with nature-study.

Science Methods. Nine weeks, Senior year. Laboratory work, reading, written reports. The aims of this course are: (a) to give the student some skill in laboratory technique; (b) to develop a rational method of teaching nature-study.

a. Technique is acquired in connection with the study of the developing tadpole and germination of seeds. It consists in preparing histological material, sectioning, staining and mounting microscopic slides, in demonstration of the circulation of the blood, and the preparation of the normal solutions and reagents, the use of the automatic and the hand microtome and the preparation of mounted plant tissues.

b. The nature-study method is taught by the study of a concrete object in which the natural steps in the study of an object are shown and actually taken. Reading and discussions of a book on nature-study method will occupy part of the time in this work. Each member of the class is expected to make a careful study of a bird and to present a written account of his observations.

NORTHERN ILLINOIS STATE NORMAL SCHOOL, DEKALB, ILL.

In the Department of Science the courses conducted by Professor F. L. Charles and assistants, include meteorology, nature-study, zoology, human physiology, botany, physics, chemistry, and elements of agriculture. The aim of the department is to prepare teachers of nature-study, and it is the purpose so to unify the different courses as to make each contribute to this end without sacrificing the peculiar interests of any subject.

Meteorology. Five hours for twelve weeks.

A course in elementary science, with special reference to weather phenomena. Recording of local data; physics and chemistry of the atmosphere; forecasting; weather study in the grades.

Nature-Study. Four hours for twelve weeks.

Identification and study of birds during migrating and nesting season. Birds as fitted to mode of life. Bird calendar. The school garden. Garden calendar.

The school "Zoo"; wild and domesticated animals. Children's pets. Plant and animal societies. Pond, river, meadow and grove.

Biology. Four hours a week. Biological study runs through the entire year, the work of the three terms being unified so far as possible. For a complete biological survey it is desirable, therefore, to enter the class at the beginning of the fall term.

The fall term will be devoted, in the main, to the subject-matter and method of zoology; the winter term, to human anatomy, physiology and hygiene; the spring, to botany; but leaf-fall cannot well be studied in the springtime, nor bird nesting in the fall, and this formal division is modified to allow for topics suggested by the seasonal changes.

It is believed that nature-study can best be taught by those who, through thorough preparation, have attained a comprehensive view of the biological field. Today, even to the kindergarten teacher, a broad scientific foundation is essential; hence the organization of these courses on a scientific, rather than a nature-study, basis.

Physics. Five hours for twelve weeks. A consideration of general physical topics, not including heat, light, sound, magnetism and electricity. Treatment of one of the five topics mentioned.

Chemistry. Five hours for twelve weeks. A study of the more important elements and their compounds. Inductive development of chemical laws. Ventilation; the atmosphere; chemistry of familiar things.

Advanced Nature-Study and Agriculture. Senior year, elective. A consideration of the work in nature-study and elementary science throughout the grades during the fall, winter and spring terms. Field excursions; choice of subject matter; collection, preservation and study of material: intensive treatment of a few topics appropriate to season; a course of nature-study for the grades; the literature of nature-study; values and aims; relations to other subjects; observation and discussion of lessons in the grades. This work will be helpful not only to grade teachers but also to prospective teachers of high-school science.

SAM HOUSTON NORMAL INSTITUTE, HUNTSVILLE, TEXAS

One-fifth of the time in the Department of Natural History is devoted to nature-study, that is in studying and in training our pupils to teach from that point of view. Printed outlines prepared by the teacher serve as a general guide. One day in the week is set apart especially for this work. Of course, the general courses in zoölogy and botany afford many opportunities, in the other four days of the week, for assisting along this line.

W. Coleman.

ONTARIO PROVINCIAL NORMAL SCHOOL, OTTAWA, CANADA

Speaking generally, the students at entrance have a minimum academic standing equivalent to that of ordinary university art students at the beginning of second year [college sophomore]. They have had from one to three years of high-school training in chemistry, in botany, and in physics, and have also taken one-half year of professional training and have taught for at least one year.

The immediate aim of the Normal School work is to prepare students to teach the course of studies recently prescribed for all grades of Ontario elementary schools. The Normal School course extends over one year. The class-room time devoted to the subject of nature-study is two three-quarter-hour periods per week during the year.

The students pay a number of visits to the Experimental Farm at Ottawa. They also attend the Ottawa Field Naturalists Club excursions every Saturday afternoon during the spring and autumn months and the course of lectures given fortnightly by the Club during the winter months.

The pupils of the Model School have frequent afternoon field excursions, and Normal School students each take charge of half a dozen. They also teach nature-study lessons under criticism in the Model School.

Each student makes a somewhat thorough experimental study of the life-history of one plant, one tree, and one insect, procuring, caring for, and mounting specimens and making water-color drawings and written observations at respective stages.

Students are also required to gain a fairly good working knowledge of the more important flora and fauna of the vicinity (thirty-three trees, sixty-five birds and fifty common plants). They also take a course in physics. In manual training they construct their own nature-study apparatus—plant-carriers, etc. They take enough practical work with microscope and electric lantern to enable them to manipulate the instruments without difficulty.

A genetic functional treatment is adopted throughout. The United States books which most nearly represent the nature of the work done are Hodge's "Nature-Study and Life," and Coulter's "Plant Relations."

S. B. SINCLAIR.

CORNELL UNIVERSITY, COLLEGE OF AGRICULTURE

A two-year special course in nature-study is offered. This course is designed to help persons who expect to teach nature-study and country life subjects in the public schools. Persons actually engaged in teaching and also all persons in the University who signify their intention to teach are eligible. A certificate will be given on the completion of sixty hours in the courses prescribed below, together with such other work in the College of Agriculture as may be approved by the Director.

(a) SUBJECT-MATTER COURSES

Botany, three hours, throughout the year. Botany, two hours, second half-year. Invertebrate Zoölogy, two hours, first half of first half-year. Entomology, three hours, second half-year. Systematic and Economic Zoölogy, two hours, throughout the year. Geology, three hours throughout the year. Soils, three hours, first half-year. The Homestead, two hours, first half-year.

(b) PRACTICE IN NATURE-STUDY

Nature-Study. Lectures and discussion of methods. Credit, three hours[1]. Mrs. COMSTOCK.

Home Nature-Study Work. Work in the training classes in the Ithaca schools in which students are also to take part. Credit, one hour. Mrs. COMSTOCK.

Practice Work in Nature-Study in the public schools of Ithaca, comprising school room work, excursions, and other exercises with children. Credit, two hours. Miss MCCLOSKEY.

School-Gardens, comprising actual garden making with children on school grounds and in the University school-gardens. In winter the work will be conducted in the forcing houses where plant growing subjects will be taken up in such a way as to adapt them to elementary school conditions. Credit, one hour.

Nature-Study. Advanced course. Individual work on special problems Professor BAILEY, Mrs. COMSTOCK, and Miss MCCLOSKEY.

Students are requested to attend Professor DEGARMO'S "Philosophy of Education."

As expressed in the preceding Announcement of Courses, the students in nature-study in the Cornell University College of Agriculture obtain their subject-matter in the regular science departments. This gives accurate foundation for out-of-door study.

Under the second category, Practice in Nature-Study, the students are taught point of view and are given an opportunity to work out their ideas, having the benefit of discussion and criticism of their fellow students and instructors.

The course in practice work in Nature-Study has been taken up

[1] At Cornell one hour credit means one hour of recitation or two of laboratory work for a half-year.

this year with a great deal of interest and increase in numbers. There are twenty-one members in the class, three men and eighteen women. The public schools of Ithaca are used as laboratories for this work. In some instances, the students take charge of nature-study in an entire building; in other cases, inexperienced teachers are given a single class or the opportunity to work with some one who has pedagogical knowledge and experience. Each student is practically free to work out his ideas The success of his work is measured by results and it is the purpose to give originality an opportunity to develop.

As yet, no permanent grounds have been secured for school-gardens in Ithaca (although temporary quarters are in use), but the work in childrens' gardens was carried on with success last spring, and increased interest and activity are expected during this year.

MACDONALD INSTITUTE, GUELPH, CANADA

The Department of Nature-Study under Professor S. B. McCready, with the coöperation of Professor Lochhead of the Ontario Agricultural College, aims especially to prepare teachers to take up nature-study with their pupils, in connection with a school-garden, and to deal with the simpler aspects of general nature-study. It is open to actual teachers.

OUTLINE OF THREE MONTHS' COURSE

School Gardens. Planning and keeping of school garden plots; keeping of garden records; studies of growths in different plants; control of weeds, insects, etc.

Agriculture. Study of experimental plots and farm crops; excursions to Poultry, Horticultural and Dairy Departments.

Botany. Ecology of plants, including buds, fruit spurs, etc., study of trees and plant societies; identification of flowering plants, grasses, weeds, etc.; physiology of plants; collections.

Zoology. Ecology of insects; excursions for study of birds, mammals, and other common animals; pond life; collections.

Geography. Study of the surface of the land, an introduction to geography and geology.

Geology. Excursions for the study of soils, rocks, minerals, and land forms; operation of dynamic agencies, such as rain, frost, rivers, winds, etc.

Weather and Climate. Weather observations, weather maps, and the climate of Canada.

Astronomy. Elementary work; movement of heavenly bodies; constellations.

Special Problems. Development of frog; stages of currant saw-fly, etc., relation of insects to plants; value of birds, toads, etc., to the garden and the farm hibernation forms of insects and insect homes; migration of birds, etc.

Methods of Teaching Nature-Study. Lectures, with practice and criticisms; pedagogical psychology.

Nature in Literature. Reading and discussion of literature dealing with various phases of nature.

Art. Special attention will be given to the training of teachers in clay-modelling, drawing, sand modelling, and color work, as means of expression well adapted to all sides of nature-study work.

Manual Training. Elementary exercises in cardboard work and woodwork; use of knife and simple tools; series of models for ungraded schools.

Conferences. For discussion of methods and specific subjects, mainly by students, in presence of teachers.

ONE YEAR NORMAL COURSE

A more advanced course, of a similar nature, and extending over a full College year, is given to teachers who wish to qualify as specialists in this department. The aim is to provide instructors fitted to carry on the work of nature-study and school gardens in a group of rural schools, in a large consolidated school, or in an agricultural high school.

TEACHERS COLLEGE, COLUMBIA UNIVERSITY

In this institution nature-study is understood to be the simple observational study of common natural objects and processes for the sake of personal acquaintance with the things that appeal to human interest directly and independently of the principles of organized science. All the "natural science" studies of the elementary schools, so far as the teaching rests on actual studies of nature, are regarded as included in nature-study. Nature-study with such a general point of view must draw its materials from the fields of the several natural sciences, and for this reason the science departments of Teachers College coöperate in the work of training teachers of this special line. Subject-matter courses in the physical, geographical, and biological (including physiological and agricultural) aspects of nature-study are given by the respective departments of science; and the relations of the subject-matter of the various phases, together with the theory and practice of the teaching, are presented in special courses in education conducted conjointly by the professors of physical science, geography, and biology. And in addition to the science and education courses directly relating to nature-study, there are open to students courses in general elementary and kindergarten method, manual

training, physical education and hygiene, and educational psychology, which are important for the proper appreciation of the numerous interrelations of nature-study in the elementary-school curriculum.

After this year the work of all departments of this institution will be limited to professional courses designed primarily for Junior and Senior years for the Bachelor's degree and for graduate students. The problems of nature-study are, therefore, radically different from those obtaining in normal schools which must deal largely with students entirely without experience in teaching and with no more than high-school training, for most students now come to Teachers College with normal training or its equivalent for two years in advance of high school and large numbers have had experience in teaching.

A major for the Bachelor's degree and an additional diploma mentioning special training for teaching may now be taken in nature-study. The requirements are 60 points (a point is one hour lecture, or two hours laboratory work for a half-year) for the Junior and Senior years. Of these 60, 44 are prescribed as follows:

General and Educational Psychology, six points, Professor Thorndike; History and Principles of Education, six points, Professor Monroe; Lectures on teaching of nature-study, two points, Professors Bigelow and Woodhull: Practical course (including teaching under criticism in school and garden), four points, Professors Bigelow and Woodhull and Miss Broadhurst; Teaching in Elementary Schools (general theory and practice), six points, Professor McMurry: Biological Nature-Study (subject-matter course in plant and animal natural history and elements of agriculture), four points, chiefly in laboratory, field, garden and greenhouse, Professor Bigelow and Miss Broadhurst; Physical Nature-Study (subject-matter drawn from physics and chemistry), Professor Woodhull and Miss Van Arsdale; General Geography, six points, and Teaching Elementary Geography, two points, Professor Dodge and Miss Kirchwey; Applied Biology, including human physiology, four points, chiefly in laboratory, Professor Bigelow.

The remaining 16 points (most students have completed some of above required courses in other schools and therefore have more points elective) may be selected with great freedom. Commonly, courses in the science departments, manual training, elementary drawing, and such other courses as are needed for well-rounded preparation of a special teacher of nature-study are advised.

Students preparing for the general elementary school work and who do not expect to become special teachers or directors of nature-study

are advised to find time for one course in animal and plant natural history and one in physical nature-study and, if possible, supplement them with the education course on nature-study. However, the latter is usually impossible for the overcrowded program, and such general elementary teachers must depend for methods upon the course in elementary methods (Professor McMurry) which is required.

Full descriptions of work relating to nature-study and related courses mentioned above may be found in a special circular and in the Annual Announcement of Teachers College, which may be obtained from the Secretary.

PEABODY COLLEGE FOR TEACHERS, UNIVERSITY OF NASHVILLE

Biological Nature-Study

The Department of Biology, directed by Professor J. S. Caldwell, offers a course in Biological Nature-Study intended to give the prospective teacher sufficient knowledge of materials and methods to do intelligent and effective work with children in the public schools. No attempt to plan a model course is made, nor is especial emphasis put upon pedagogical methods, since these are given attention in courses in education. A series of animals and plants is taken up, mainly those which form the immediate environment of every child, from the standpoint of economic biologist rather than that of naturalists or simon-pure biologists.

For this work Hodge's "Nature-Study and Life" is used. While the book does not supply a statement of the biological principles which must be understood by the teacher before his work can be more than mere repetition, it puts into his hands an immense amount of well-organized usable material, and is free from the glaring blunders found in books written by those not primarily biologists. With it to draw from, the teachers' work can not degenerate into the meaningless study of leaf-forms and search for curiously shaped flowers which has too long stood for nature-study.

Students are put into touch with the work of the United States Department of Agriculture, and taught to look upon it as their only never-failing ally. The series of papers upon nitrifying bacteria and soil inoculation are taken up and discussed, cultures made, and the experimental plots are being kept under observation. A batch of students from the "Cotton States" spent some time in digesting the literature upon the cotton boll-worm, giving the results of their work to the class in the form of reviews. Others studied means for destroying the English sparrow, others worked over the life history and methods of prevention of corn and wheat weevils.

Thus the attempt is made to make the student an independent investigator and to keep his work with children within the limits set on the one hand by his equipment, or lack of it, and on the other by the popular demand that the work of the school be practical and useful.

Geographical Nature-Study

A certain phase of nature-study is carried on in connection with the work in physiography, under Professor P. H. Manning. The region about Nashville presents many of the characteristic features of an erosion topography. Peneplains, showing three cycles of erosion stand out boldly in Middle Tennesse. These peneplains, dissected more or less completely by streams, present a varied and interesting topography and constitute an admirable field for out-door study. Classes are conducted into this field to study these phases of erosion and this sequence of topography. On these trips classes study the decay of rocks and formation of soils together with the fact that different kinds of rocks produce by decay very different soils with varying degrees of fertility. They see examples of alluvial soils, soils in place, transported soils, inherited soils, etc.

THE UNIVERSITY OF CINCINNATI

The pressing demand would seem to be first, to give teachers some definite goal toward which to direct their efforts, and secondly, to jostle them out of their bookish habits and drill them in direct observation. The next step is to lead them to a satisfactory point of view from which to direct the observations of children. This accomplished, it becomes necessary farther to instruct them in the most practical methods of collecting and keeping the materials necessary for their work. Lastly, it is important to advocate a system of presentation in the schools that is equally applicable to many forms of life, and the following out of which will not upset the order of things to any great extent.

The nature-work at present in the Teachers' College of this University is confined to courses in animal life and in plant life, but courses in other branches are soon to be offered. The present work is presented wholly from the interpretative aspect, which is the child's view-point.

With living things there are really only four problems that vitally concern the individual organism. These are the questions, (1) of food, (2) of self protection, (3) of adjustment to physical surroundings, and (4) of provision for the young. Every important thing about an animal or a plant has to do with one or more of these necessities of life. Consequently the study of plant or of animal life becomes simply a question of studying different forms to see how their structures and habits adapt them to these occupations, and how they compare with other forms in these respects. It is manifest that

any one of the topics can be followed out in just as small or as great detail as is desirable. This gives an underlying purpose for the observation in any case and thus at once captures the interest of either teacher or child. (For an elaboration of this method the reader is referred to the *Pedagogical Seminary*, Vol. 12, No. 1).

In the training course the teacher is brought face to face with as many forms as is consistent with thorough work. While the question of activities and life relations is emphasized through discussions and field work, still in the training *of adults* the writer has found nothing that can give a secure foundation for an adequate understanding of the activities of living organisms but intensive study of types in the laboratory, where the student can get concentrated and directed training in observation and deduction. For this reason, a liberal use is still made of "comparative anatomy" which, it seems, it has become fashionable to decry at present. However, in the study of any organ, the question of its function or "adaptation" is always kept foremost.

As regards the emotional phase of nature-study, no efforts are made toward inculcating sentiment beyond what the personal enthusiasm of instructors may impart. The student is given references, however, to a few of the nature poets and to some of the more inspiring and truthful accounts of our so called literary naturalists.

MICHAEL F. GUYER.

DEVICES FOR OBSERVATION IN NATURE-STUDY

By D. R. WOOD

State Normal School, San Jose, Cal.

[EDITORIAL NOTE.—The following article ought to suggest to many teachers in normal, secondary, and elementary schools, that some of their own devices for facilitating study of living things in the school may be new and interesting to very many readers of this magazine. You are again invited to write to the Managing Editor concerning any special devices which you have found successful, but which you believe not to be in common use.]

The Window Cage for Schoolroom Observation

Unless observed under natural conditions, animal life in nature-study presents many difficulties; the principal one among these is the bringing of the live animal into the schoolroom. For example, if a bird is brought in a cage, it must necessarily be so small that the animal cannot act normally, and the children are unable to see its characteristic movements. Birds may be observed temporarily in

small cages, notwithstanding the fact that one of the aims of nature-study is to teach kindness and sympathy for all life; but captivity for any great length of time without suitable conditions is not practicing what one teaches. Comparatively few animals that are brought to school can be allowed to run at large, and there must of necessity be some place in which to put them where they may be observed.

In the California State Normal School, at San Jose, a cage has been built which is of great aid in teaching concerning animal life. It

Window cage as viewed from the schoolroom.

obviates some of the more serious difficulties, because suited to the needs of both animal and observer; and at the same time, it furnishes opportunity for continuous observation.

Just outside the window and resting on its ledge, is a cage built of wood, glass, and wire-netting. It is placed so that the window pane

furnishes one side of the enclosure. This window can be raised, a moveable screen may be placed in open space, and at all times the children may hear the call or cry the animal is making, and observe

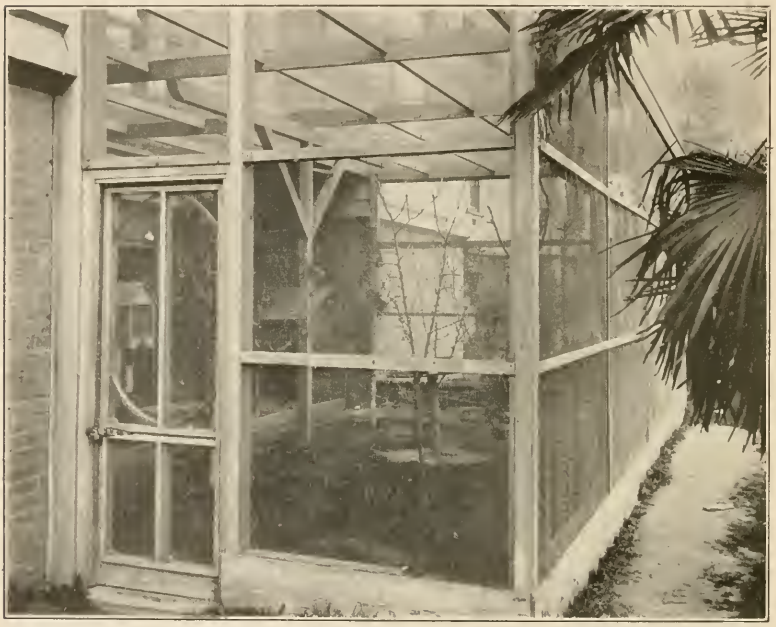
Window cage as seen from outside the building.

what is going on. The three outer sides are made of wire-screening, and above this the cage is glazed to its eaves. The roof is so built as to shed rain. For the purpose of changing the sand or cleaning the cage a zinc tray is fitted to its floor.

In the first picture, two ring doves are the objects of the study.

The mother bird may be seen in one of the lower corners sitting on the nest. The young were hatched in this nest. The children watched the parent birds as they cared for the little ones. In this same cage at different times have been placed rabbits, guinea-pigs, white mice, chipmunks, a young fox, owls, hen and chickens. If rodents are to be kept for any length of time it necessitates substituting zinc for wood.

This arrangement has been a great convenience to the teacher and a pleasure and profit to the children.



Flying cage for outdoor observation; thirty-six feet long, eighteen wide and twelve high.

The Flying Cage for Outdoor Observation

A flying cage is another convenience in the teaching of nature-study, and is almost indispensable in the intimate study of bird life. Our cage is large enough to admit a whole class of children, and if at times this is not practicable, they may observe from the outside. The cage is located on the side of the building nearest the playground, and is so placed that the children can see and hear what is going on at any time. The watching of the birds furnishes amusment and pleasure when the children are not otherwise engaged about the

grounds. Being so conveniently situated, they learn much about animal life without directed effort, and interest is awakened in observation of other birds in their wild state.

This cage is thirty-six feet long, eighteen feet wide, and twelve feet high. It is built in a niche in the wall of the building, which wall furnishes one side and parts of two other sides of the cage. The exposed portions are covered with a wire-netting. In a corner most protected from the wind, a portion of the roof eight feet square is covered with boards. Under this covering are roosts and a glass house in which are many suitable perches and resting places. There is also a little house nearer the ground in which large birds may stay, and under it is a space for squirrels and chipmunks. The bottom of the cage is made mice and rat proof by sinking boards one foot wide and encasing them in cement. These boards are carried around the whole cage. A sink furnished with running water and large enough to admit of some forms of water life is sunk into the ground; this is a suitable place for water birds to swim. Bathing basins for the smaller birds are conveniently arranged about the cage floor. Grass covers the greater portion of the floor, with here and there sand and dust spots.

Plants of various kinds are grown to afford the birds shade and protection from the hot sun. Most of the plants are deciduous, in order that the required amount of sun may be procured during the winter.

Two kinds of seeds are needed for the birds. To protect the small seed from disturbance by the coarse seed eaters, a little platform, about two feet from the ground is covered with a wire-netting house, into which open four doors, one on each side, just large enough for the largest of the small birds to enter and feed.

Boxes and such devices as are considered best for nests are distributed about in suitable places, and during mating season, bits of string, paper, grass and feathers are scattered on the ground that the birds may have material with which to build natural nests.

Hens, peacocks, coots, wild ducks, pheasants, etc., in their season of study, are allowed their freedom in this cage for a time. Only such birds are kept here permanently as have been raised in captivity. It is of course necessary to study the habits of birds and other animals in order to know which may be kept in the same cage without danger of the weaker being injured.

MACDONALD SCHOOL GARDENS OF CANADA

THE NATURE-STUDY REVIEW has already given, especially in No. 1, 1905, and in No. 2, 1906, much information concerning these gardens; and several other papers describing the work in particular gardens are in preparation for early publication. The following excerpt from a paper by Inspector R. H. Cowley (*Queen's Quarterly*, 1905, pp. 390-418) will help readers to understand better the point of view which controls the Macdonald Gardens.

"Three leading motives underly the origin and growth of school gardens in Europe:—(1) to provide a convenient means of supplementing the teachers' income, thereby simplifying the problem of maintaining the public school; (2) to promote a practical knowledge of horticulture and agriculture, thereby increasing the national prosperity; (3) to furnish means and material for the practical study of botany as a desirable department of scientific knowledge.

The vast majority of European school gardens look to utility. Of the few that recognize the importance of the educational end, nearly all stop short at the acquisition of a certain amount of scientific information and the habit of careful observation. On the other hand, the Macdonald School Gardens, while designed to encourage the cultivation of the soil as an ideal life-work, are intended to promote above all things else symmetrical education of the individual. They do not aim at education to the exclusion of utility, but they seek education through utility and utility through education. The garden is the means, the pupil is the end. The Macdonald School Gardens are a factor in an educational movement, and for this reason Professor Robertson sought to have them brought under the Education Department, and not under the Department of Agriculture in each province. The fact that the various provinces already referred to have passed orders in Council incorporating the Macdonald School Gardens into their educational systems at once places these school gardens on a broader educational basis than that occupied by the school gardens of any other state or country.

The Macdonald School Gardens not only have a recognized place in the provincial systems of education, but they are attached to the ordinary rural schools, owned by the school corporation and conducted under the authority of the school trustees and the express approval of the rate payers.

The work of the garden is recognized as a legitimate part of the school programme, and it is already interwoven with a considerable part of the other studies. The garden is becoming the outer class-

room of the school, and the plots are its black-boards. The garden is not an innovation, nor an excrescence, nor an addendum, nor a diversion; it is a happy field of expression, an organic part of the school in which the boys and girls work among growing things and grow themselves in body and mind and spiritual outlook.

The true relation of the garden to the school has been in good part established by the travelling instructors whom Professor Robertson appointed to supervise the work in each province."

NATURE-STUDY AND GARDENING FOR INDIAN SCHOOLS

A pamphlet of instructions recently sent out by Superintendent Estelle Reel of the Office of Indian Schools outlines primary methods for use of teachers and urges upon agents and local superintendents the importance of nature-study and gardening for Indian pupils.

"In view of the fact that a majority of Indian children have land and are accustomed to out-of-door life, it is of paramount importance that they be given instruction that will combine physical training and recreation in the open air and at the same time educate them to see the possibilities in their land, and give them practical knowledge that will enable them to obtain the most lucrative results from its cultivation. . . . . Instruction in nature-study should be taken up when pupils first enter school and be made the basis for writing, language, and number work. . . . . Instruction in nature-study should comprise facts and principles that will be useful to pupils on the farm and in the home garden. It should include the germination of seeds, the important parts of plants and the usefulness of these plants to man; how plants grow and develop; the names of the vegetables of the locality; the relation of soil, water, air, heat, and plant food to plant growth, and the means to be employed in checking the ravages of injurious insects."

Directions for simple experiments on germination, effect of moisture, heat, depth of planting, and kind of soil; and directions for gardening make up the pamphlet. Since the pupils know little or no English, the work is necessarily very elementary. But so far as it goes it is very practical.

Concerning the garden work the following extracts are of general interest even to those who have no connection with the special schools for which the directions are given.

"Instruction in gardening should occupy an important place in Indian-school work, and special efforts should be put forth by the

schoolroom teacher to give pupils training that will fit them upon leaving school to secure from the cultivation of their land the best results. . . . .

"The individual garden is preferred, as it involves responsibility and develops the individuality of the pupil. The individual garden work should be emphasized when the child is small. As he grows older and is able to do more work he should be actively employed in the actual farming operations, the school garden being the connecting link between the class-room instruction and the farm work. The plan for the gardens best suited to existing conditions should be adopted. Beds four by six feet for the smallest children, gradually increasing in size according to the advancement of the grade up to nine by fifteen feet, have been found by many schools to be satisfactory. . . . . At the Riverside school, Oklahoma, the big garden to supply vegetables for the school is divided into fifteen squares, corresponding to the number of tables in the dining room. Each square contains 900 square yards. A large boy is seated at one end of a table and a large girl at the other, with smaller boys and girls at the sides. Each of the large boys that sit at the ends of the tables, aided by the smaller ones that sit at his table, plants and cultivates one of these squares. Each square is a garden complete in itself, and so far as practicable the vegetables raised on it are to be eaten at the table belonging to the boys that planted and cultivated the particular square. This plan has been tried for the past four years, and it appears to stir up a friendly spirit of rivalry, which increases the interest. . . . .

"When the beds have been prepared careful instruction should be given in seed planting. . . . . When a new weed appears, a specimen may be brought into the class room to be examined. . . . . The garden beds may be cultivated, when the weather will permit, two or three times a week. . . . . A rotation of the crops which can be raised in the neighborhood should be practiced in the garden, planting a new crop as soon as one has been taken off the ground. . . . . If injurious insects appear on the plants, instruct the class how to destroy them. . . . . Something of the importance of encouraging the birds to nest on the farm should be explained. . . . .

"When vegetables mature, have each pupil make a careful record in his notebook of the kind and quantity harvested, and encourage him to try to increase the yield each year. In day schools where more vegetables are raised than are required at the time for the midday luncheon, they should be stored for winter use. Pupils should also be allowed to take some home to their parents where the quantity

justifies this. The parents should be educated through the day schools to enjoy a vegetable diet and thus realize the necessity for conducting a home garden. At several boarding schools the surplus production of vegetables raised by the pupils was sold and a bank account started for each pupil.

"Explain fully the advantage of raising vegetables of the best quality in order that they may command the highest market price. This may be accomplished by using only the best seed and supplying the soil with necessary plant food, giving careful attention to the cultivation of the garden and arranging the products in an attractive manner for the market. Strive to show the importance of learning what crops will best repay the labor and how to dispose of them to the best advantage. Lay special stress on instruction in figuring the expenditure in labor and money, also the returns in amount and value of the crops, that pupils may know how to estimate the result of their labor.

"In addition to window boxes, many of the schools have hotbeds in which plants are started for transplanting. . . . .

"It is hoped that teachers will recognize the necessity of correlating agricultural instruction in the class room with teaching the children to speak English. These suggestions have been prepared to assist them in accomplishing this and in making their methods more effective and more directly aimed at laying the foundation for the thorough training in practical agricultural work which will fit their pupils for becoming successful farmers and capable, upon taking up their allotments, of making a living for themselves and their families."

BIRD STUDY FOR THE FIFTH GRADE

BY LAURA B. UNDERHILL

Teacher of Grade V, Horace Mann School, New York

The nature-study of the primary grades of the Horace Mann School directs attention to and aims to arouse interest in a few very common birds. The outline for the fifth grade attempts a somewhat extensive and at the same time intensive study of birds, especially placing emphasis upon their relations to man and his economic interests.

The time allowed for bird study is about one hour per week (three 20-min., or two 30-min. periods) for the equivalent of a half year. The other half of the year is given to the topic "Trees in their Relations to Man." We study birds first in the autumn so as to get some acquaintance before the migration, then the winter residents, and finally return to bird study in the spring. A similar arrangement for the three seasons is made for the parallel tree study.

The following outline has been the basis for the work for three years:

Birds—Autumn, winter and spring—parallel with studies of trees—(a) Study living and mounted birds in schoolroom in order to give acquaintance with general form, parts and uses of the body. (b) Field studies of common birds—identification, movements, migration, food, records of observations. Individual work should be stimulated. (c) Studies of habits of young chicks and ducks. (d) If possible, class should visit Zoological Park to observe some of the striking modifications of birds in adaptation to habits of life. (e) Economic relations of some common birds; value of our domesticated birds; bird protection by special societies and laws; birds for decoration.

In this grade, as in fact in all others in this elementary school, three aims are prominent: (a) to give general acquaintance and interest, (b) to develop habits of careful observing and reasoning, and (c) to give some useful knowledge concerning common natural things as they affect "human interests."

As to methods of conducting the study, the most important is the note-book. We use the common covers for perforated sheets of paper. White sheets serve for notes and a grayish paper of soft texture is used for pasting colored pictures of birds and clippings from magazines. Moreover, we lose no opportunity for cultivating appreciation of good literature and short selections are often written in the note-book. From time to time the teacher gives the pupils mimeographed sheets containing information and these are added to the note-books. The pupils are very proud of these books. One book last year had on the cover in large letters the title "A Superior Reference Book for the Study of Birds, by ——— ———."

The class work begins early in the year with some discussions of the main topic "Birds in their Relation to Man," attempting to draw together and organize the facts based on the experiences of pupils of the class and at the same time to get them to see that birds are worth studying. This introduction does not fail to arouse great interest, and thus we make a good start in bird study. A small proportion of the time is given to this introduction, but it is strongly emphasized throughout the course when the habits of each bird are studied. The result is that the pupils realize the beneficial relation of the birds to agriculture, the important service they perform as scavengers, and the much needed protection of our game and song birds.

The injurious relation to man must of course be mentioned. Here arises opportunity for the cultivation of good judgment on the part of the pupil when he is allowed, after carefully weighing both sides, to judge whether the points in favor of a bird are enough to warrant destroying it or not.

The introduction is followed by some study of the bird structure, which is needed for field work and identifying birds. In this work live pigeons and parrots, stuffed birds, bird skins, skeletons and charts are used. We simply study the chief external parts of the bird's body and their uses.

During the autumn and winter we keep blackboard records of individual observations of fall migrations and winter birds. Another space on the blackboard is devoted to individual observations. These can never be accurate because they are made by untrained observers in various places. All reasonable ones are accepted for the sole purpose of arousing and keeping alive the interest in the study and encouraging outdoor activity.

Sections of the class under the guidance of the teacher make excursions, often before school in the morning, to Central Park where careful observations are made. Twenty-seven different kinds of birds have been accurately identified in a single morning. Strong emphasis is placed upon accuracy and doubtful observations reported to the class are noted on the blackboard as demanding more evidence.

Constant reference is made to a set of colored pictures, arranged for the purpose of easy inspection, as a frieze around the room. These are placed in the order of the spring arrival of the birds. Stuffed specimens such as are not available at Teachers College are loaned by the Museum of Natural History, giving a more intimate knowledge of the coloring than can be obtained from the bird in his native haunts or from even the best colored plates.

Through the kind interest of a nature lover an instructive talk, illustrated by microscopic slides, showing the development of a feather, was given to last year's class; and by the kind coöperation of interested parents and friends who loaned their membership tickets, the entire Fifth Grade and many of the Fourth were able to attend the stereoptican lectures on birds at the American Museum of Natural History.

One of the most important results of the work is the constant training in accuracy, not only of eye and ear, but *accuracy of statement*, which affects all other branches of study in this grade. Here is certainly something of practical value in the nature work of the present day.

Certain bird games have been tried for the purpose of testing the memory and familiarity with the subject. In one game where seventy-two birds were to be identified in a given time from stuffed specimens and pictures, more than two-thirds of the class knew half the number and one pupil knew sixty-seven of the seventy-two.

That the interest and active work often continues after the pupil leaves the fifth grade is shown by the collection of old nests, eggs and other interesting materials brought in by former pupils of this grade. A few years ago, at the suggestion of some of the enthusiastic pupils, a Nature Club was formed in order that the work begun in the fifth grade might be continued. The club at present has twenty members from the high school and upper grammar grades. The meetings are held twice a month and many very good papers written by the members have been read and discussed. The class-rooms and specimens at the Museum of Natural History have been kindly opened to the Club, and much interesting and profitable work has been done there. Every applicant for membership must write an original paper showing some knowledge of birds. That the Club has a waiting list of nearly one dozen children testifies to the continued interest in this study.

The bird work offers excellent opportunity for correlation with art, language, and literature. Selections from John Burroughs, Wm. J. Long, and Florence Merriam have been used in the reading lessons (not as nature-study). The following poems have been found helpful, many of them having been memorized by the class: Bryant's "Robert of Lincoln;" Thaxter's "Robin" and "Sandpiper;" Drake's "Mocking-bird's Song;" Carey's "Blackbird;" Coolidge's "Discontent;" Longfellow's "Birds of Killingworth" and "Birds of Passage;" Holland's "Life in the Nest;" Lowell's "The Nest;" Larcom's "Brown Thrush," "The Snow Bird," "Birds with Bosom Red;" Van Dyke's "Veery," "Song Sparrow," "Maryland Yellow Throat," "Whip-poor-will."

The following reference books are recommended, those with a star being particularly pleasing and valuable for children: Weed and Dearborn's "Birds in their Relation to Man;" Chapman's "Birds of Eastern North America;" *Chapman's "Bird Life;" *Dugmore's "Bird Homes;" Blanchan's "How to Attract the Birds;" Apgar's "Birds of the United States;" *Olive Thorn Miller's "First Book of Birds" and her "Second Book of Birds;" *Weed's "Bird Life Stories."

Many very helpful bulletins are issued by the Department of Agriculture. The following have been successfully used by the pupils: "Four Common Birds;" "Blue Jay and its Food;" "Meadow-lark and Baltimore Oriole;" "Birds as Weed Destroyers;" "Food of Nestling Birds."

NOTES ON NEW BOOKS AND PAMPHLETS

Agriculture for Beginners. By C. W. Burkett, F. L. Stevens, D. H. Hill. Boston: Ginn. New Edition with supplement.

This well and favorably known guide to elementary agriculture has been improved by the addition of a supplement of about sixty pages, dealing with common vegetables, flower and window gardening, forage plants, sugar cane, and cotton-boll weevil.

Nature Study Lessons. By Mrs. Lida B. McMurry. New York: Macmillan. 1905. Pp. 190. 60 cents.

This is a series of lesson plans for primary grades, dealing with about twenty common animals and ten plants. The lessons are worked out along interesting lines, and the book will be very useful to beginners who must have definite guides in their nature-study teaching.

Window Gardening. By H. B. Dorner. Purdue University, La Fayette, Ind.

A very practical little bulletin dealing with pots, window-boxes, potting plants, watering, insect enemies, fertilizers, propagation from seed and from cuttings, and other things which interest growers of house plants. The most satisfactory plants for schoolrooms are geraniums, Asparagus Sprengeri, ferns (sword, Boston, Pierson and Scott), primroses and various bulbs. Full directions concerning them are given. A limited edition of the pamphlet is being distributed by the President of the University.

Boys and Girls Magazine. Ithaca, N. Y. Monthly. 50 cents a year.

The latest issues of this interesting nature magazine for children, edited by Martha Van Rensselaer, contains many short articles on pet animals, birds, insects, plants, and physical phenomena in which children are likely to have an interest.

How to Know Wild Fruits. By Maude G. Peterson. New York: Macmillan. 1905. Pp. 340, ill.

This is "a guide to plants when not in flower by means of fruit and leaf." There are many guides to flowers, by which we most commonly identify plants; but in these days when country life has so many devotees there is need of guides based on characteristics visible in months other than those when plants flower. This field-book will be useful so far as colors of fruits may be the starting point towards identification. The descriptions are clear and the book seems workable for any reader who has a little knowledge of high-school botany.

An introductory chapter on "Adaptations of Fruits and Seeds for Dispersal" is in general open to the questions which have been raised in this magazine in No. 6, page 262, 276; and No. 7, page 39.

There are indexes to common and scientific names, a synopsis of plant families and definitions of terms used.

Nature-Study and Literature. By Anna E. McGovern. Chicago: Flanagan. 1905. Pp. 332.

This is a series of type lessons for primary teachers. Its aim is to correlate nature-study with literature, language, and picture study. The book contains such a large number of suggestions for correlations that no adequate review can be given in a limited space. The book is one of the best available for selections to be read, and moreover its suggestions will be helpful. It should be in the possession of all teachers who are trying to work out correlations of nature-study with literature.

Report of Winnebago County, Ill., for 1905. As one looks through this annual report just issued by Superintendent O. J. Kern, Ill., it is hard to believe that one is "Not among the Swiss Alps, but in Winnebago County." It would almost appear that Superintendent Kern is in the midst of a second edition of the Garden of Eden and that he and his people had been placed there by the "Lord God to dress it, and to keep it," and that all signs seem to indicate that they are doing their work well.

The report is rich in illustrations, especially on the side of the school-garden, practical agriculture and the school environment. Superintendent Kern is to be congratulated upon the success that has been attained in the rural schools of Winnebago County along the line of school-gardens and in the practical work done by the boys in The Boys' Experiment Club in elementary agriculture. Such work as this counts. It will create a body of intelligent, wide-awake young farmers in Winnebago County who will make life on the farm worth living. May the day hasten when more work of this character may be done in our rural schools. L. A. HATCH.

Teacher's Course in Nature-Study. By F. L. Stevens and Mrs. Stevens. Raleigh, N. C.: State Dep't of Public Instruction.

The first eighteen pages of this pamphlet give an outline by months for seven grades, and cover a wide range of living and lifeless nature. It is planned for four lessons per month. The second part gives suggestions for elaborating the outline.

Industrial Education for Rural Schools. Report of Committee to National Educational Association, July, 1905. Pp. 97. For sale by Irwin Shepard, Winona, Minn. Price 10 cents.

This report, signed by L. D. Harvey, Chairman, L. H. Bailey, Alfred Bayliss, W. T. Carrington, and W. M. Hays, is such a comprehensive survey of everything important connected with the subject that THE NATURE-STUDY REVIEW can best serve its readers by calling attention to it and suggest-

ing that copies be ordered for careful examination. It contains much valuable material on nature-study, elementary agriculture, and school-gardens.

Hampton Leaflets. The following recent issues of this useful series of nature-study leaflets have been received. "Fruits of Trees" (Nov. 1905); "Spring Blossoms of Shrubs and Trees" (March, 1906).

The Nature Guard. The following recent issues of the R. I. Agricultural College correspondence series have been received: "Scale Insects" (Lesson 45); "Two Wood-Carvers," flicker and downy woodpecker (Lesson 47); "Hints for Home Gardeners" (Lesson 48).

Field and Forest Club. Those interested in clubs for outdoor study will find suggestions in the 1904–1906 Year-Book of the Field and Forest Club, Dorchester, Mass.

School Garden Leaflets. Nature Leaflets 29, 30, 31, 32, published by the Massachusetts State Board of Agriculture (apply to Secretary of the Board, Boston) are devoted to school-gardens. They were written by H. D. Hemenway, Director of the Hartford School of Horticulture.

Audobon Educational Leaflet No. 17 deals with the American goldfinch. An excellent colored plate, a duplicate one in black and white, and a reprint of the article "Sunflowers for Goldfinches," by Miss Hale, published in THE REVIEW for January of this year, are supplements to the leaflet. The leaflet is issued by Mr. William Dutcher, President of The National Association of Audobon Societies, New York.

Study of Insects. The monthly bulletin of the Division of Zoology, Pennsylvania State Department of Agriculture, begins in the January issue a systematic survey of insects. The bulletins are free upon application to the Economic Zoologist, Professor H. A. Surface, Harrisburg.

Maryland Plants. A recent issue of the Maryland Agricultural College Bulletin is devoted to an illustrated account of Maryland plants from the nature-study point of view. It was prepared by Professor F. H. Blodgett.

Garden Correlations. A chart showing the numerous correlations between garden work and other subjects at the Hyannis (Mass.) Normal School has been published by B. M. Brown, Hyannis, Mass. Price 15 cents. It will be very helpful to those who are working on the problems of correlation in the garden and other nature-study work.

Wild Birds of Iowa. By B. H. Bailey. Cedar Rapids: Audobon Nature Publications Co. A simple little guide to 200 common birds.

Queen Bees. A very complete and interesting account of natural and artificial methods of rearing queens is given by Dr. E. F. Phillips in Entomology Bulletin 55, of the U. S. Department of Agriculture.

NOTES FROM SCHOOLS

Poisonous Plants and Grazing Animals. In a lesson recently given in a New York private school reference was made to poisonous plants, e. g., laurel, as protected against grazing animals. A bright child made the following sensible comment: "How could a poison thus protect a plant? If animals eat the leaves and die, how can they learn to avoid the poisonous plants? It seems to me that the poison is simply *an accident of birth.*" This comes very near expressing the views of many biologists who are skeptical about the explanations of use viewed from our human standpoint.

ANNA N. BIGELOW.

Interest of Pupils. As suggestive of the interest agriculture is bringing to the schools, one of our teachers at our recent summer school said that she had difficulty in getting the pupils to school at the opening hour in the morning. Her agricultural class was immediately after lunch hour in the afternoon. She said that she had noticed that all the pupils were interested in this study, and that she never had any tardiness or lack of interest when this recitation was held. Noting this fact, she transferred the agricultural class to the first thing in the morning and gave all of the pupils in school lessons in agriculture and nature-study. At once tardiness came to an end. She had found the secret of interesting her pupils in education, and after that she had no difficulty in securing a full attendance, and having her rolls free from tardiness.

C. W. BURKETT.

NATURE NOTES

Color Changes in Spotted Newt. A chameleon-like change of color in the common spotted newt Diemyctylus has been recently described by C. G. Rogers, of Syracuse University. He has noticed that under certain conditions these salamanders changed color in a remarkable manner. When the animals were exposed to low temperature they assumed a darker color. When the water in which they lived was raised to a higher temperature they became lighter, and when the temperature of the water became normal they resumed the color they had at the beginning of the experiment. If the temperature was kept constant and the intensity of the light changed they responded as follows: if placed in darkness they became darker, and vice versa; but these results were less pronounced than the temperature experiments. The author believes that the change of color is probably controlled by the sympathetic nerves. (*Biological Bulletin*, Vol. 10, pp. 165-170, March, 1906.)

ELONIA ANDRE, Detroit High School.

Manufactured Comb Honey. For seventeen years the editor of *Gleanings in Bee Culture* (Medina, O.) has been offering $1000 reward for a sample of manufactured honey in comb perfect enough to deceive the ordinary purchaser. No one has claimed the reward and we may conclude that the story of manufactured honey was a newspaper joke. Of course, it is easy to adulterate extracted honey, but obviously it would be no easy and inexpensive task to imitate closely the work of the honey-bees in modelling the comb, and then filling and capping the cells.

Honey-Bee in America. Referring to the note on Australian bees in the March number (Vol. 2, p. 116) of this magazine, Professor Cockerell states that the article was inaccurate in stating that a bee of the genus Apis, to which our common hive-bee belongs, is indigenous in America.

Ice in Plants. An interesting paper on this topic is in the February *Plant World*. Dr. Wiegand, of Cornell University, finds that ice ordinarily forms between the cells and not in the cells of plant tissues.

Vitality of Buried Seeds. Bulletin 83 of the Bureau of Plant Industry, U. S. Dept. of Agriculture, brings out the following points of interest in connection with elementary agriculture and school gardens: The length of time seeds will retain their vitality when buried is obviously of great importance in the extermination of weeds. The experiments show that seeds of many of the worst weeds when plowed under will be destroyed by decay if left undisturbed for some years. Most seeds of cultivated plants lose their vitality quickly when buried in soil, while "weed" seeds retain their vitality much longer. The most pernicious weeds have seeds which live long when buried. Hard seeds and unhulled seeds retain their vitality longest in the soil. Seeds of all kinds are best preserved in a dry and comparatively cool place. Seeds buried near the surface are destroyed more quickly than those planted very deep.

Black Locust Trees. In recent years large numbers of Robinia pseudacacia have been planted for ornamental and economic purposes, especially for railroad ties and fence posts. Its excellent qualities are rapid growth, easily started, and durable wood. But according to C. A. White, of the Smithsonian Institution, insect enemies make it an undesirable tree for planting. One insect larva tunnels the leaflets, another produces gall-like enlargements of the tender twigs in which eggs are deposited, and a beetle larva burrows extensively in the wood of branches and trunk. All these insects live only on the black locust. No practicable remedies for use on a large scale are known. These facts and notes on the life-histories of the insects are given in *Popular Science Monthly*, Vol. 68, pp. 211–218, March, 1906.

Cheat Changing to Wheat. The weed known as cheat or chess which often appears suddenly in wheat fields, has long been believed by many people ignorant of the principles of botany to originate from wheat, particularly in seasons unfavorable to wheat. The experiments referred to in the note above seem to show that cheat seeds do not long remain dormant in soil, and that probably the unexpected appearance of cheat is usually due to its having been recently sown with wheat or other grains or with manure.

NEWS NOTES

Practical Nature-Study. Principal Myron T. Scudder of the State Normal School at New Paltz, N. Y., is working for the formation of an Ulster County Country School Press Club, the purpose of which will be to disseminate through every county paper, information and suggestions concerning the work of the country schools. He is also trying to organize nature study clubs in every school and when the spring planting season fairly opens some of these schools will go into out-door nature-study work, the planting of school-gardens, the study of elementary agriculture, the keeping of bees and the incubation of eggs. All these things are practiced at the model department of his own school. An incubator cellar has been fitted up and hundreds of chickens have been raised during the past three years. The chicks are put into an in-door brooder in the large primary room where the little children feed and water them, and use them individually as living material for clay modeling and painting. After a few days they are transferred to out-door brooders and colony houses, hawk-protected, on the campus where they are cared for until commencement time, when they are distributed amongst the children to take home. During the process of incubation eggs are broken open from time to time so that the children may watch the embryos. This work gives abundant opportunities, not only for nature-study and for biological study, but for related activities in the carpenter shop, as well as in drawing, painting, composition work, cooking, food values, etc.

Miss Jean Broadhurst, formerly assistant in botany in Barnard College, now instructor in biology and nature-study in the New Jersey State Normal School, has been appointed instructor in biology and nature-study in Teachers College, Columbia University. She will give special attention to the plant side of nature-study in botanical and educational courses for teachers-in-training.

Mrs. Mary H. Hunt, the originator and leader of the movement for temperance instruction in connection with public school physiology, died at her home in Boston April 23rd.

Professor William Lochhead has removed from the Ontario Agricultural College to the new Macdonald College, Quebec, where he will develop a department of biology and nature-study.

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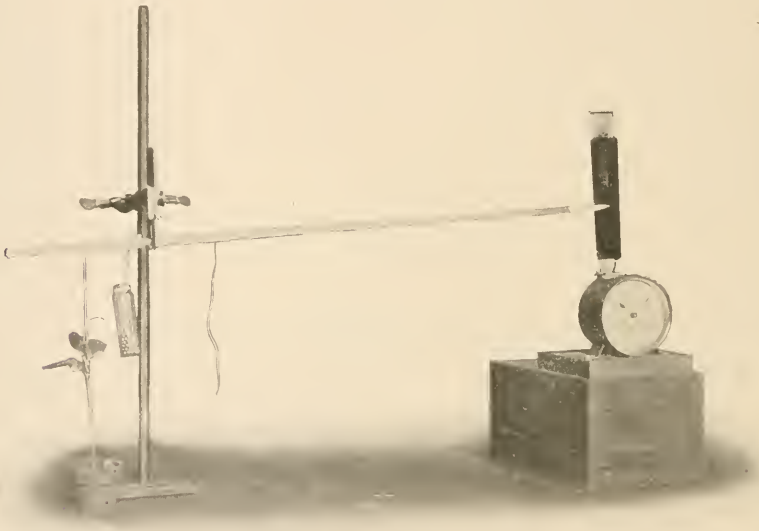

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CONTENTS OF No. 1, JANUARY, 1905

Nature-Study and Natural Science—A Symposium, H. W. Fairbanks, C. F. Hodge, T. H. Macbride, F. L. Stevens, M. A. Bigelow. Physical Nature-Study, John F. Woodhull. Nature-Study and Elementary Agriculture in Canada, W. H. Muldrew. Some Recent Criticism of Nature-Study, F. M. McMurry and H. E. Armstrong. Agriculture in Southern Schools, C. W. Burkett. School-Gardens at Hartford School of Horticulture, H. D. Hemenway. Ant-Nests for Schools, Adele M. Field. Guide to Periodical Literature, Ada Watterson.

CONTENTS OF No. 2, MARCH, 1905

Educational Values and Aims of Nature-Study, S. Coulter, H. W. Fairbanks, M. A. Bigelow. Principles of Nature-Study, J. M. Coulter. Children's Gardens at Worcester, Mass., Illustrated, Edna R. Thayer. Why Some School-Gardens are Failures, T. R. Croswell. Chemical Tablets for Feeding Plants Growing Without Soil, Illustrated, Edward F. Bigelow. A Nature-Study Lesson with Moulds, F. L. Stevens. Nature-Study in High Schools, M. A. Bigelow. Guide to Periodical Literature, II., Ada Watterson.

CONTENTS OF No. 3, MAY, 1905

Why Many Fail in Teaching Nature-Study, L. A. Hatch. Ready-Made Lessons in Nature-Study, L. C. Miall. Flower Shows in City Schools, Alice R. Northrop. Observation Bee-Hive for the Schoolroom, Anna Botsford Comstock. Window Gardens for the Schoolroom, H. D. Hemenway. A Wild-Flower Garden, Isabella G. Diggings. Making a School Lawn, Margaret T. Brown. Time Required for Nature-Study, S. B. Sinclair. Method of Sherlock Holmes in Nature-Study, E. A. G. Lamborn. Original Observations from Elementary Schools. Guide to Periodical Literature, III, Ada Watterson.

CONTENTS OF No. 4, JULY, 1905

Nature-Study versus Agriculture, W. M. Hayes. Nature-Study and Agriculture, Anna Botsford Comstock. Nature-Study and Agriculture, F. L. Stevens. Nature-Study in School of Nova Scotia, A. H. MacKay. Teaching Facts in Nature-Study, John Dearness. Nature-Study and its Relation to English, W. M. Heiney. The Silk-Worm for Nature-Study, Alvin Davison. Protective Colors of Animals. Facts Discovered by Children, T. D. A. Cockerell. Guide to Periodical Literature, IV., Ada Watterson.

CONTENTS OF No. 5, SEPTEMBER, 1905

Relation of Geography to Nature-Study, with Complete Outline of Courses for Eight Grades, H. W. Fairbanks. Value of Knowing Names of Natural Objects, Many Writers. An Educational Bee-Hive, Edward F. Bigelow. Do Birds Eat Butterflies, T. D. A. Cockerell. School-Gardens in Philadelphia. School-Garden Notes, H. D. Hemenway. A Plea for Wild Flowers. An Appeal for the Birds. Nature-Study in New Zealand. Nature Notes.

CONTENTS OF No. 6, NOVEMBER, 1905

The Communal Life of Ants, Illustrated, Adele M. Fielde. Study of Deciduous Trees in Winter, Clarence M. Weed. The Children's School Farm in New York City, Illustrated, Fannie Griscom Parsons. Temperance Physiology Sixty-six Years Ago, M. A. Bigelow. Plants That Hide from Animals, M. A. Bigelow. Facts Discovered by Children, Marion H. Carter. Guide to Periodical Literature, Ada Watterson Yerkes.

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Vol. 2, No. 5
WHOLE NO. 11

May, 1906

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CONTENTS

	PAGE
The Work of a Children's Museum. Illustrated. ANNA B. GALLUP	153
Hygiene in Elementary Schools. BERTHA M. BROWN	164
Best Books for Nature-Study. Many Writers	168
True Nature-Study and its Fundamentals. J. V. CRONE	177
Introducing Agriculture into Schools	185
Notes	189

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THE NATURE-STUDY REVIEW

CONTENTS OF No. 1, JANUARY, 1905

Nature-Study and Natural Science—A Symposium, H. W. Fairbanks, C. F. Hodge, T. H. Macbride, F. L. Stevens, M. A. Bigelow. Physical Nature-Study, John F. Woodhull. Nature-Study and Elementary Agriculture in Canada, W. H. Muldrew. Some Recent Criticism of Nature-Study, F. M. McMurry and H. E. Armstrong. Agriculture in Southern Schools, C. W. Burkett. School-Gardens at Hartford School of Horticulture, H. D. Hemenway. Ant-Nests for Schools, Adele M. Field. Guide to Periodical Literature, Ada Watterson.

CONTENTS OF No. 2, MARCH, 1905

Educational Values and Aims of Nature-Study, S. Coulter, H. W. Fairbanks, M. A. Bigelow. Principles of Nature-Study, J. M. Coulter. Children's Gardens at Worcester, Mass., Illustrated, Edna R. Thayer. Why Some School-Gardens are Failures, T. R. Croswell. Chemical Tablets for Feeding Plants Growing Without Soil, Illustrated, Edward F. Bigelow. A Nature-Study Lesson with Moulds, F. L. Stevens. Nature-Study in High Schools, M. A. Bigelow. Guide to Periodical Literature, II., Ada Watterson.

CONTENTS OF No. 3, MAY, 1905

Why Many Fail in Teaching Nature-Study, L. A. Hatch. Ready-Made Lessons in Nature-Study, L. C. Miall. Flower Shows in City Schools, Alice R. Northrop. Observation Bee-Hive for the Schoolroom, Anna Botsford Comstock. Window Gardens for the Schoolroom, H. D. Hemenway. A Wild-Flower Garden, Isabella G. Diggings. Making a School Lawn, Margaret T. Brown. Time Required for Nature-Study, S. B. Sinclair. Method of Sherlock Holmes in Nature-Study, E. A. G. Lamborn. Original Observations from Elementary Schools. Guide to Periodical Literature, III, Ada Watterson.

CONTENTS OF No. 4, JULY, 1905

Nature-Study versus Agriculture, W. M. Hayes. Nature-Study and Agriculture, Anna Botsford Comstock. Nature-Study and Agriculture, F. L. Stevens. Nature-Study in School of Nova Scotia, A. H. MacKay. Teaching Facts in Nature-Study, John Dearness. Nature-Study and its Relation to English, W. M. Heiney. The Silk-Worm for Nature-Study, Alvin Davison. Protective Colors of Animals. Facts Discovered by Children, T. D. A. Cockerell. Guide to Periodical Literature, IV., Ada Watterson.

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CONTENTS OF No. 6, NOVEMBER, 1905

The Communal Life of Ants, Illustrated, Adele M. Fielde. Study of Deciduous Trees in Winter, Clarence M. Weed. The Children's School Farm in New York City, Illustrated, Fannie Griscom Parsons. Temperance Physiology Sixty-six Years Ago, M. A. Bigelow. Plants That Hide from Animals, M. A. Bigelow. Facts Discovered by Children, Marion H. Carter. Guide to Periodical Literature, Ada Watterson Yerkes.

THE NATURE-STUDY REVIEW

CONTENTS OF No. 7, JANUARY, 1906

The Evergreens, ANNA B. COMSTOCK. What to teach in Nature-Study, L. A. HATCH. Gold-Fishes in Japan, K. MITSUKURI. Definite Problems in Nature-Study, S. B. SINCLAIR. A Simple Experiment on Spontaneous Generation, F. L. STEVENS. Sunflowers for Gold-Finches, DELIA M. HALE. Science and Nature-Study Parallel, W. M. HALLOCK. Scientific Nature-Study, an Abstract, M. A. BIGELOW.

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Nature-Study and Manual Training, W. A. BALDWIN. The School-Garden at Bowesville, Canada, E. A. HOWES. Nature-Study in its Practical Bearings, J. P. STEWART. Place of Physiology in Elementary Schools, M. A. BIGELOW.

CONTENTS OF No. 9, MARCH, 1906

School Gardens, B. M. DAVIS. Nature-Study and Manual Training, M. A. BIGELOW. The Sap-Current: An Experiment. Illustrated. F. L. STEVENS. Nature-Study in City Primary Schools, M. C. DICKERSON. Galls and Gall-Flies, Illustrated. V. L. KELLOGG. Nature Notes.

CONTENTS OF No. 10, APRIL, 1906

Training Teachers of Nature-Study: A Series of Reports from Normal Schools and Colleges. Devices for Observation in Nature-Study, Illustrated. D. R. WOOD. Macdonald School Gardens of Canada. Nature-Study and Gardening for Indian Schools. Bird Study for Fifth Grade, L. B. UNDERHILL. Notes on New Books and Pamphlets. News Notes. Nature Notes.

CONTENTS OF No. 11, MAY, 1906

The Work of a Children's Museum. Illustrated. By ANNA B. GALLUP. Hygiene in Elementary Schools, BERTHA M. BROWN. Best Books for Nature-Study, By MANY TEACHERS. True Nature-Study and its Fundamentals, J. V. CRONE. Introducing Agricultural Instruction into Public Schools.

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We are now *compelled to change this system* because the facts stated on advertising page 4 of the March issue make it *necessary to economize* by making sure that no more copies are printed hereafter than are needed for *actual paid subscribers.*

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THE
NATURE-STUDY REVIEW

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

VOL. 2 MAY, 1906 NO. 5

THE WORK OF A CHILDREN'S MUSEUM

BY ANNA BILLINGS GALLUP, B.S.

Curator of Children's Museum, Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y.

A museum for children is the natural outgrowth of the need, long recognized by parents and educators, of opening to children attractive fields of interest, and through that interest leading them to wholesome activity.

Although small loan collections are doing excellent service in many public schools, and teachers with classes of children are no longer unfamiliar visitors in the public museums of European and American cities, a museum whose aim is to appeal directly to the child's mind, in its collections and methods of imparting knowledge, is a development of recent date, and one of the new departures of the Brooklyn Institute of Arts and Sciences.

The origin and early history of the Children's Museum properly belongs with an account of its later work, in partial explanation of its methods of development.

The city had taken for a public park the beautiful grounds of a fine old residence in the Bedford section of Brooklyn, and was going to remove the dwelling when a group of public-spirited citizens saved it. Arrangements were soon made for the Brooklyn Institute to occupy and use the building, the city providing, by an annual appropriation, for its maintenance and operation. The immediate need of the Institute was temporary storeroom and exhibition space for its books, apparatus and exhibition material saved from a fire. Upon the opening of the new Museum Building on the Eastern Parkway, however, the more valuable property was tranferred to the new quarters, while enough of miscellaneous material remained to form the beginnings of a smaller museum. The combination of an attractive building and a picturesque park suggested the practicability of a museum centre in

which children might happily and profitably employ their leisure moments. A children's museum thus brought into the educational arena began its pioneer work in December, 1899, in two small exhibition rooms on the first floor and with a few scattered specimens of birds, insects, molluscs, etc., mostly from Long Island.

The collection and preparation of new exhibition material adapted to the needs of children, and the evolution of practical methods for getting people interested in a novel undertaking, were among the problems of those early days. As the city appropriation could be used only for maintenance, the little museum had to depend upon small allotments from the General Museum Funds of the Institute, the energy of its workers and the generosity of friends, for all new acquisitions. It quickly became popular, the records for the first year of its history showing an attendance of 65,000 visitors. The unconscious advertising of the children attracted the attention of their teachers who subsequently looked upon the museum as a

The Children's Museum, a remodeled old residence.

helpful source of information in connection with the nature-study and science work of the schools.

Early in 1900 a Children's Museum Reference Library was opened on the second floor of the building. The library was started as an aid to children in studying the museum collections and the subjects they suggested, its books and periodicals coming from the income of the Graham Fund of the Institute, and a small annual appropriation from the State. Starting with less than five hundred books the library now contains over five thousand volumes composed of the best works on natural history in the broadest use of the term. It supplements the work of the museum in providing books of information to members of the museum staff in the preparation of collections, in furnishing additional information to visitors, and in offering books on the lines of school work, thus forming a valuable school reference library, adapted to give assistance to teachers and pupils of all ages. A choice of the best stories of animal life has been included as a means of arousing interest in the great world of nature which seems entirely outside the observation and sympathy of many city children.

The books are carefully classified and placed upon open shelves where they are easily accessible to all readers, and volumes required for the study of any special subject can be consulted without formality. Although it is considered most desirable that the Museum Library should be a reference library only, in order that all books may be in readiness for use at any moment, the privilege of the home use of books over night or over Sunday is now granted to any teacher or student.

The library has closely followed the growth of the museum which has gradually broadened its scope and enlarged its collections to include botany geography, minerals, United States history, and art. These collections now fill all available space in the eleven exhibition rooms of the present building and are named according to the character of material displayed. The first floor contains the bird, botany, insect, mineral, and zoölogical type rooms, and the second floor the mammal, shell, geography, art, and history rooms.

The reader may know the saying that "the finished museum is a dead museum." From this viewpoint, the Children's Museum is just now very much alive. No one realizes more keenly than its workers the imperfections of its equipment. The lack of sufficient funds for the rapid acquisition of good specimens, and the necessity of using objects we are anxious to discard, will long keep us from

that blissful peace of mind which is so often associated with the idea of a finished product. Commonplace objects, however, take on a new significance when the arrangement adapts them to a definite use, and this has been a helpful incentive in the effort to utilize old material. In working out the collections for the Children's Museum therefore, the aims have been:

1. To employ objects attractive and interesting to children and at the same time helpful to teachers in every branch of nature-study.

2. To secure an arrangement at once pleasing to the eye and expressive of a fundamental truth.

3. To avoid confusion from the use of too many specimens and the consequent crowding in cases.

4. To label with brief descriptions expressed in simple language and printed in clear, readable type.

A description of the contents of every collection would exceed the limits of this paper, although brief reference to those features which illustrate the scope and character of exhibition material, will throw light on the educational methods followed.

The zoölogical type collection, for example, with its synoptic series extending from the Protozoa (represented by drawings) to man, presents in objective form those elementary ideas of evolution at once fascinating to children and helpful to older students with zoölogical training.

In the bird room where the young visitor may see the more common song, water and game birds of Long Island, he finds also a large case filled with the "Birds We Read About" in song and story—such as the albatross, cassowary, condor and peacock,—the labels bearing quotations from famous literary works.

The botanical collection planned especially with reference to high-school visitors is limited to the display of models, pictures and specimens supplementary to high-school courses of study.

The mineral collection not only attempts to familiarize the visitor with the more common minerals and rocks, but it also sets forth some of their uses. For example, with the quarried graphite, lead pencils are shown in progressive stages of manufacture; likewise specimens of marbles are accompanied by photographs of quarries, of men chipping and carving monuments and of buildings constructed of marble.

In the insect collection, the synoptic arrangement of typical insects answers the questions of many a high-school pupil confused in his classification. The young collector finds common Long Island insects,

so arranged and labeled that he can readily identify his captures; or if he is interested in raising caterpillars, he will find all stages in the life-histories of the moths and butterflies. Brightly colored insects from tropical lands appeal to his love of the beautiful in nature, while insect habits and insect products are illustrated in separate groups.

In the botanical collection, a case showing the morphology of roots.

The shell collection is confined to the most common types of molluscs and those forms interesting to children either for their peculiarities of shape and color, or because of their economic importance. The fresh-water bivalves employed in the manufacture of mother of pearl buttons are placed with an exhibit showing how pearl buttons are made,

another group of objects made of mother of pearl shows the uses of Tahiti shells, while the pearl oyster containing a pearl completes the section devoted to this subject.

The historical collection through its charts and relics is intended to broaden the child's interest in the history of his own country, by presenting to him in new form the subjects of his school study. One attractive feature of this exhibit is a model of a Dutch homestead on Long Island in 1640, showing characteristics of architecture, household decorations, gardening, and dress of that period.

An exhibit in the shell collection, showing how buttons are made.

Throughout all the exhibits pictures are freely used to give life and attractiveness to the subject and every room contains something alive. Honey-bees, ants, spiders, snails, fish, newts, frogs, turtles, snakes, lizards, rabbits, a guinea-pig, rats, mice, and an owl, are cared for in neatly kept aquaria and cages, and growing plants add their touch of color in the sunny windows. The younger children are always interested in living animals and the same children come day after day to gaze at their favorite objects of life study.

In 1904, the Children's Museum which had hitherto developed independently became a branch of the Central Museum of the Institute.

Although the reorganization made no radical change in the methods of working with children and teachers, the closer union with the larger and stronger museum brought material aid in the development of collections.

As the purpose of the museum is to give pleasure to children and a wholesome interest in the world of nature, every effort is made to render the rooms and exhibits attractive. All privileges of the Museum and Library are free from 9:00 A. M. to 5:30 P. M. on every week day in the year and from 2:00 to 5:30 P. M. on Sundays. Children especially are made to feel that the museum has a welcome for them as long as they do not trespass on the rights of others, and some member of the staff is always ready to answer questions or to explain in detail anything of especial interest. It is also the desire of members of the staff to meet all visiting teachers and acquaint them with such museum facilities as may be helpful in school work.

Attendance is voluntary and children are free to choose their own ways of enjoying the museum. Some prefer to wander independently from one room to another, stopping now and then to read a label, or watch some living animal; and later, retire to the library for an hour with the books. Others, especially the younger visitors, enjoy having some member of the staff take them around, explain everything and answer innumerable questions.

The popular half-hour talks attract children of all ages, according to the nature of the subject presented. These talks are regularly given in the museum lecture room which seats sixty pupils comfortably. The monthly schedule provides one talk each week for the primary grades and for each grammar grade. The subjects for discussion—chosen with reference to the public school courses in nature-study, geography, and physics—are supplementary in character, and are illustrated with specimens, lantern slides, charts, or experiments as occasion requires. The regular talks are given at 4:00 P. M. on school days and 10:30 A. M. and 2:30 P. M. on Saturdays, to avoid confliction with school hours. Additional talks are often given, upon request, to teachers and classes interested in subjects not discussed in the regular talks, or to those who are unable to reach the museum in time for the four o'clock meetings.

In the absence of any official relation with the public school system the museum seeks to extend its service wholly by direct appeal to any who find it helpful. Recognizing the great importance of co-operating with teachers in its efforts to reach the child, it began, in 1902,

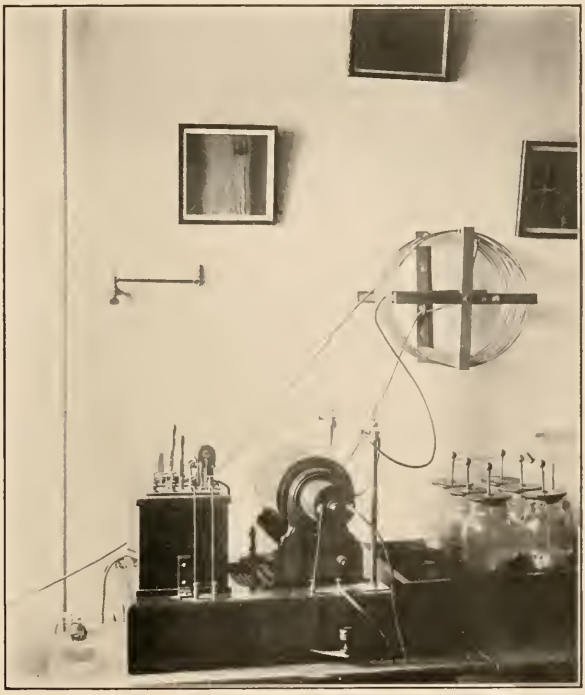
to publish a monthly paper for free distribution among the public and private schools of Brooklyn. This little paper, more recently combined with a similar publication from the Central Museum and now known as the *Museum News*, is issued from October until June and is a regular means of spreading information concerning the improvements and changes in the progress of the Museum and Library, and

A view in the room devoted to the mineral collection.

of advertising the monthly schedule of half-hour talks. It is regularly mailed to principals for distribution among such teachers as may be interested, and is given to children and others who apply for it in person. It is also sent to museums and educational institutions all over the world.

Within the past year we have established half-hour talks in general physics and electricity, and also a weekly conference when the

lecture room is thrown open to older boys and girls who wish to examine pieces of apparatus used in the talks, to construct their own simple appliances or to perform experiments. The talks were given in response to repeated requests from children and teachers in the upper grammer grades where little illustrative apparatus is available for physics work. The conferences, which have proved a



The wireless telegraphy apparatus set up and operated by boys interested in the museum.

fruitful source of enjoyment and incidental instruction, have opened the way for some boys to place a wireless telegraph apparatus. The boys have done all the work of installing, adjusting and operating the system, are now able to send messages to various parts of the city and to receive from Philadelphia, Boston, and ships 300 miles at sea.

As the success of any venture may fairly be judged by results, the reader may naturally inquire as to the fruits of this unique Children's

Museum work. In summarizing evidences of its progress it is only fair to remember that its field of labor is centered in the heart of a great city with a shifting population and that of the thousands of children who come temporarily within its influences many, through change of residence, soon lose sight of it altogether. For such we can only hope that their brief museum experience has opened to them some new field of enjoyment. From among the permanent homes of the neighborhood, on the other hand, the museum records an encouraging number of high-school pupils who became its patrons when in the lower grammer grades. Each year some new phase of nature appeals to them and the museum has in every case assisted in the pursuit of some hobby.

Many a child has testified to the fuller enjoyment of his summer vacations because of the increased stock of information unconsciously absorbed in the spare moments devoted to the museum; and teachers invariably tell us that their pupils who come to the museum regularly take a higher rank in school work—as a primary devotee once expressed it "Our teacher likes to have us come here because it makes us wise"

A teacher from a near-by school not long ago told the writer that the owl lesson she prepared so carefully unexpectedly developed into an "experience meeting" in which every one wanted to testify as to what he had seen the live owl do at the Children's Museum.

Whereas four years ago it was difficult to get school principals to take the trouble to distribute the museum paper and the majority of teachers in every school knew nothing about the Children's Museum, the *Museum News* is now faithfully distributed and the existence of the museum has become known in nearly every school. Many of the teachers announce the subjects of the half-hour talks to their classes and give additional credits to children who attend them.

Some principals who formerly denied to their teachers the privilege of bringing classes to the museum in school hours, on special occasions now permit them to start early in the afternoon, if the object of the visit is the supplementary study of a school subject. More than 75 public schools, 40 private schools and 6 high schools in Brooklyn continue to send teachers and pupils to the museum.

During 1905, 14,727 children attended the half-hour talks, and 380 visits from school teachers and principals in search of definite information were recorded. The general average attendance for the past four years has exceeded 94,600 each year.

Although the Children's Museum has made only a beginning, it is

rapidly approaching the limit of growth in its present quarters. Its exhibition rooms and library shelves are already occupied and new accessions cannot be placed without overcrowding.

Requests from teachers for the privilege of bringing larger classes for talks are reluctantly refused because the lecture room is so small. In 1905, the average attendance at the talks was 68, necessitating in some cases the repetition of the talk in order that children might not be disappointed.

For the lack of funds rather than from failure to see the desirability of it, the Children's Museum has no system of lending natural history specimens to schools. Its supply of loan material is limited to a few boxes containing life-histories of insects and duplicate birds retired from exhibition. Teachers are obliged to call for and return borrowed specimens as there is no other means of distributing and collecting.

Teachers have frequently expressed the wish that their own schools were nearer the museum so that their children could often visit it and the schools of the immediate neighborhood are finding it of practical help.

We, who have seen the Children's Museum grow from its infancy, anticipate with much interest a larger museum movement in the future. The demand for the work which a branch museum can do is so clearly proven in the case of the Children's Museum, as to suggest the multiplication of similar centres to serve the different localities of a large and growing city. These under a financially strong Central Museum, with a staff of specialists to provide exhibition and loan material, might easily become centres for the evolution of museum methods in adaptation to local needs, and through supplementary talks in co-operation with the schools, loan specimens and helpful exhibition material, accomplish on a larger and better scale what the Children's Museum is now working for. Some method of taking the museum to the children must be found if the city is to afford all equal privileges in this new line of education.

The first step toward a new Children's Museum has already been taken in the form of a bill before the State Legislature asking permission for the city to erect a new building in place of the present structure at the cost of $150,000. This movement is evidence of the recognized success of the Children's Museum experiment. If with improved equipment the Children's Museum can render broader and more efficient service to the community, perhaps the branch museums may become familiar landmarks in the less fortunate parts of our city.

HYGIENE IN THE ELEMENTARY SCHOOLS

BY BERTHA M. BROWN
State Normal School, Hyannis, Mass.

If there is one hopeful feature about the public schools of today, it is their improvement. We are all familiar with a day's program in an elementary school at the present time. There is the usual succession of lessons in arithmetic, grammar, writing, and geography, relieved somewhat by nature-study, music, physical culture, and manual training. Comparing the program of fifteen years ago with that of today, we note that some new subjects have appeared, others have dropped out. But what can we say of those subjects that appear in both programs?

In arithmetic of former times, we should have heard the children recite long rules and solve still harder problems. Today, we may find them at work on problems more or less connected with practical life. We may even find them solving problems by the shortest and the quickest methods. In geography, naming all the capes, bodies of water, rivers, and lakes of a continent was considered the goal of ambition. Today that is changed, we find children making a map of their own neighborhood or town; educators have discovered home geography. In the study of foreign countries, the people and their industries now claim their proper amount of attention. In grammar, it was formerly thought necessary to parse every word in Gray's "Elegy in the Country Churchyard." Today, the amount of time given to technical grammar is limited and more time is given to literature.

The question now arises, can we point to a similar gain in the teaching of that subject called in the course of study, anatomy, physiology and hygiene? Formerly, most of the time allotted to this subject was devoted to the effects of alcoholic stimulants. The text-books for grammar and even primary schools taught about cells and other microscopic anatomy. We should indeed have to make a careful search if we are to find many improvements in the teaching of this subject. Perhaps time would be better spent in suggesting improvements.

The teaching of hygiene is only one part of a larger subject, namely, the good health of children. The teacher is only partly responsible for the good health of the children under her care. She shares with the parents, the school principal, the superintendent, and

the board of education, the responsibility of keeping the children in good health. Each of these has his own duty to perform towards the child. The school-board sees that the surroundings of the child are healthful. It is responsible for a school-building that is not only pleasant but sanitary as to its ventilation, heating, lighting, plumbing, and bathing facilities. The superintendent, the principal, and the teacher share the responsibility of the teaching in the course of hygiene. To a certain extent, they should see that the pupils put into practise the laws of health taught in the class-room. The help of the parents is very necessary. Evidently, the parents' chief duty is to keep the child well by proper care, food, clothing, and cleanliness. In some schools the medical examiner assumes the responsibility in regard to contagious diseases and diseases of the eyes and ears. In a few instances a trained nurse is engaged to carry out the suggestions of the school physician. Occasionally, school-boards have found it necessary to supply food to the children.

The question still remains as to what shall be taught during the time allotted to hygiene. There are certain general principles that should apply to this as well as to the other courses in the elementary schools. In the first place, the subject-matter should be adapted to the age and to the intelligence of the child. There are many facts about dress, breathing, cleanliness, and other topics of hygiene that children can understand as well as their elders. The time when children begin to take pride in looking well is the best time to teach them to dress properly. Habits of neatness and cleanliness formed when young will seldom be outgrown. Early training in these important matters is very valuable. Fortunately, there is subject-matter enough in hygiene that is adaptable to every grade of an elementary school. The subject-matter should be hygiene or good health rather than anatomy or physiology. Is it not time to discover good health as well as home geography?

The following outline will indicate how the subject of "Clothing, How to Dress Properly" may be taught in an intermediate grade of an elementary school:

Why we dress—To keep warm; to protect the body; for ornamentation.

Materials used for clothing—Kinds of material: cotton, linen, silk, wool, rubber, fur, feathers, leather; uses of each.

The weight of our clothing—As light weight as possible for warmth, weight suspended from shoulders.

Airing our clothing—Air day clothes during the night; air night clothes during the day.

Bed clothing—Mattress and spring better than feather-bed; warm, light-weight covers; woolen blankets desirable.

Clothing of feet—Keep feet warm and dry; overshoes, gaiters, thick soles and high boots for outdoors; slippers and light shoes, but not overshoes and rubbers in the house.

Clean clothing—Change of clothing; garments of wash material when possible; clean linen and boots.

The fit of our clothing—Tight clothing, effect on body; difference between well fitting and tight clothes.

It naturally follows that the lessons in hygiene should be closely connected with the lives of the children. Every teacher should have a certain amount of freedom in teaching hygiene. "No one course in hygiene can be planned for all children of a certain grade any more than one kind of dress of one material, of one make, of one color, or of one size can be worn by all children of a certain age. The surroundings in which the individual child is placed determine which phases of the subject he most needs to have impressed upon him. While all the pupils need to know the general laws of health, the various classes of children need special emphasis on the subjects that will help them most in their own lives. The teacher ought to know the individual pupils and the homes from which they come. The teacher must know what the pupils are in order to lead them into better ways of living. She will need much tact in showing the children the ill effects of some habits that prevail in their homes without criticising either their parents or their homes. If we apply the same good sense and reason in teaching hygiene that we use in teaching English, history, geography, and nature-study, we cannot fail to obtain as good results."[1]

In the upper grades, the lessons in hygiene should include the principles of public health. Everyone should be intelligent on such questions as the care of the streets, the water supply, the milk supply, sewerage, lighting systems, and boards of health. In teaching these subjects, the local conditions should be explained first and other illustrations given afterwards. This connects very closely with lessons in civics.

"The lessons in hygiene may well consist of two kinds, the informal

[1]This and later quotations are from the preface to "Good Health for Girls and Boys," by B. M. Brown, published by Heath & Co.

and the formal. The informal lessons are given as occasions arise in the schoolroom. They should be brief but to the point. As an example: on a rainy day when some of the pupils have had wet feet and have dried them, a lesson may be presented on the advantages of keeping the feet dry and some of the dangers of wetting them. Informal lessons are not unprepared lessons. One needs to have the subject well in hand to be ready with informal lessons.

A formal lesson comes at the regular time set apart in the program for this subject. It may present the same topic as that recently presented in a brief informal lesson. The formal lessons may be conversational, and if any records are desired for future study, they may be kept in a note-book set aside for this purpose. A review of the subject may be obtained by reading the chapter in a good text-book on that subject. Studying from topics may vary the work. The topics may be written on the board, and the pupil may study and then recite from the topics. An experienced teacher will readily think of other ways to create and sustain an interest in the subject. While there is a natural sequence in teaching some of the topics in general hygiene, it is far more important in dealing with children that the teaching should be closely connected with events in their every-day life. The logic of the course does not appeal to the child as does the direct interest or usefulness of the information."

The lesson in hygiene should be well illustrated. "The young child naturally looks to his teacher as a living example of what she teaches. It does very little good to teach one precept, and to live another. The first duty of a teacher of hygiene is to keep herself in good condition. A teacher who is constantly illustrating the bad effects of headache and dyspepsia cannot effectively teach children what they should eat and how they should live. The teacher needs to illustrate the results of careful eating, of exercise, and of rest, as well as to show good taste and cleanliness in her personal appearance. The schoolroom, also, should be an example in its way, and should illustrate good housekeeping. It should be kept clean and tidy. The children can help in many ways to keep the desks clean and well arranged, the room neat, and the blackboards clean."

Pictures, charts, food, and articles of dress may all serve to make the teaching of the various subjects more impressive and interesting. With all the teaching we must not forget to do or to carry out the suggestions given in the lessons. The doing often precedes the talking.

"The aim of all teaching of hygiene, namely, the formation of good habits of living, should always be borne in mind. The positions of all children in writing, reading, and studying are all-important in their effect that these positions may have upon the growth. Good habits in living, like good English, can be acquired only by constant practice.

The need of teaching hygiene is unquestionable, yet those who have tried to give instruction in the laws of health will agree that it is one of the difficult subjects to teach well. Subjects like history or geography interest children readily. Many a child will listen for hours at a time to the story of some hero or read at length about travels in distant lands. In teaching hygiene our special aim is to inspire the children with an earnest desire to be well and strong. We may accomplish this end in part by making use of the child's admiration for some person who has a fine physique. Much tact and thoughtfulness are necessary in teaching children better ways of living, for the personal element in the subject is very prominent. We need rational teaching in hygiene."

Without doubt there is need for improvement in the teaching of hygiene. But where shall we look for help? The teaching to be effective must be done by the teacher in charge of the children.

These teachers need, however, encouragement, suggestions, materials, and enthusiasm. In some cases, a helpful outline with supervision would be a great help. In other cases, more extended knowledge is needed. An awakening to the importance of this subject among supervisors and principals would give the whole subject a wonderful impetus.

BEST BOOKS FOR NATURE-STUDY

The Preferred Lists of Many Teachers

The lists published below have come in response to a circular letter and a request made in an editorial note in a recent issue of this journal. There are many surprises for the reader. It was to be expected that Chapman's bird books, Comstock's insect books, Bailey's "Nature-Study Idea," Hodge's "Nature-Study and Life" Jordan and Kellogg's "Animal Life," Coulter's "Plant Relations" or his "Plants," and Blanchan's "Bird Neighbors" and her "Nature's Garden," would be named most frequently; and the fact is that no other authors are named five or more times. But it

is surprising that no author named above is listed more than thirteen times by twenty-one writers and that only three were agreed upon by more than ten people. Moreover, there are named some extremely specialized books; some books which few people would have thought of examining for help in nature-study; and some books which are certainly good reading, but of doubtful place in nature-study.

The investigation was undertaken with the hope of answering the common request of teachers for a list of about ten best books for reference. Surely few teachers of schools will have time or money for more than ten. But what are we to recommend when twenty special students of nature-study agree on only three authors by even a slight majority and give the eight most popular authors an average of seven votes each? At first this looks hopelessly confusing; but it is not entirely so. While certain books on birds and insects and plants seem to be most popular, there are several others named which may well be substituted. Also some books are obviously named because the authors of the letters have some very special interest, for example, in mushrooms. Such facts account in part for the wide range of choice.

Most surprising of all results from compiling these selected lists is the discovery that the special books on teaching nature-study have received so few votes. Books of natural history do not give the educational viewpoint of nature-study. Surely the teacher needs some special guidance in the educational principles.

The obvious tendency to turn the teacher loose with books in natural history and with few guiding principles is probably the reason why, on the whole, nature-study is still so disorganized and so far from being firmly established in our school system.

The selected lists are extremely instructive and will repay careful examination. Probably few readers would reject any of the books named if selecting a larger list of good books.

It should be mentioned that several writers of the lists given below are authors of books in the same class.

The Managing Editor originally intended to make a tabulation, but the small number of letters received and the great range of books made this impossible. Those readers who disagree with the lists published below are invited to send their own selections of books.

M. A. B.

I

The following list of books is based upon the belief that teachers, in order to present nature-study in a manner at all profitable, must have a clear conception of the intellectual significance of the subject and at the same time a "method of attack." The books are such as are suggestive along these lines, only the last titles touching upon methods of presentation. The selection has been made of books bearing upon plant and animal life, merely because of my greater familiarity with work in those lines and not as suggesting the exclusion of other subjects. Bailey—"The Nature-Study Idea." Jordan & Kellogg—"Animal Life." Coulter—"Plant Relations." Chapman & Reed—"Color Key to North American Birds." Stone & Cram—"American Animals." Atkinson—"Mushrooms." Comstock—"How to Know the Butterflies." Comstock—"Insect Life." Eckstorm—"The Woodpeckers." Cornell Nature-Study Leaflets (selected and revised edition).

PURDUE UNIVERSITY. STANLEY COULTER.

II

Hodge—"Nature-Study and Life." The most suggestive book to the enthusiastic teacher. Chapman—"Color Key to North American Birds." For one who can pay $2.50 for a book on identifying birds in all parts of the country, this is the best book. Holland—"The Butterfly Book." Best book on butterflies. Jordan & Evermann—"Game and Food Fishes of the United States." Easily the best book on the subject. Britton & Brown—"Illustrated Flora." By far the best book to identify all kinds of plants east of the 102d meridian. Each plant is illustrated. Should be in every town and high school library. Thomson—"The Story of Animal Life." This is the only book which treats of the whole animal kingdom in a brief readable form. It also gives the best brief account of Evolution and Darwinism, but does not include the recently published results of Mendel and De Vries. It is a book for teachers and normal school students and all of them should read it. Dana—"How to Know the Wild Flowers." Contains many colored and black and white illustrations. One of the best books for identifications and short descriptions of our most common wild flowers. Bailey—"The Nature Study Idea." The best book on the pedagogy of nature-study. It tells why, how, about what and by whom nature-study should be taught.

The preceding list does not contain the ten best books on nature-study for the simple reason that there are no ten books that are everywhere and always the ten best. They are all books that will prove directly helpful and suggestive to both teachers and pupils, because all give something definite. The writer is aware that the price of some puts them beyond the reach of many, but that is all the more reason why teachers should know of them and place them in libraries of towns, high schools and normal schools. A knowledge of the common forms of life is absolutely necessary in nature-study. *Nature-study means getting acquainted with life about our homes*, and for that reason the writer has given preference to books that identify and give information about common things.

ST. PAUL, MINN. D. LANGE.

III

I believe that every teacher of nature-study should in his preparation for the work have college or high school courses in science, the more extensive, the better.

As ready helps for reference, I would suggest the following as we have tested them with our own children at our summer home and find them excellent:

Blanchan—"Bird Neighbors." Coulter—"Plant Relations." Comstock—"Insect Life." Heilprin—"Animal life of our Sea Shore."

NORTHWESTERN UNIVERSITY MEDICAL SCHOOL.
W. S. HALL.

IV

Hodge—"Nature-Study and Life." Thomson—"The Study of Animal Life." Jordan, Kellogg & Heath—"Animals." Coulter—"Plants." Chapman—"Bird Life." Sedgwick—"Principles of Sanitary Science and the Public Health." Sternburg—"Infection and Immunity." Lloyd & Bigelow—"The Teaching of Biology." Kerner & Oliver—"Natural History of Plants." Cambridge Natural History. Maeterlinck—"The Life of the Bee." Peckham—"Wasps, Social and Solitary."

BAYLOR UNIVERSITY, J. L. KESLER.
WACO, TEXAS.

V.

Milton—"Tractate on Education." Frobel—"Education of Man." Spencer—"Essay on Education." Huxley—"Science and Education Essays." Hill—"True Order of Studies." Saunders—"Insects Injuries to Fruits." Chapman—"Birds of Eastern North America." Brightwen—"Wild Nature Won by Kindness." Green—"Forestry in Minnesota." Bulletins, Circulars, Monographs by the Agriculture Departments of U. S. and various States, Fish Commission and Boards of Health Reports.

CLARK UNIVERSITY. C. F. HODGE.

VI

Bailey—"The Nature-Study Idea." Hodge—"Nature-Study and Life." Scott—"Nature-Study and the Child." Coulter—"Plant Relations." Jordan & Kellogg—"Animal Life." Chapman—"Handbook of Birds." Blanchan—"Bird Neighbors." Comstock—"Manual of Insects" and "How to Know the Butterflies." Matthews—"Field Book of American Wild Flowers." Newell—"Outlines of Lessons in Botany," Pts. I and II. Eckstorm—"Woodpeckers."

STATE NORMAL SCHOOL, STEVENS POINT, WIS. JENNIE R. FADDIS.

VII

Hodge—"Nature-Study and Life." Kerner and Oliver—"Natural History of Plants." Chapman—"Birds of Eastern North America." Comstock—"Manual of Insects." Roth—"First Book of Forestry." Jordan, Kellogg and Heath—"Animals." Bergen—"Foundations of Botany." Jordan—"Science Sketches." United States and State Bulletins and special leaflets on the subjects to be studied.

CLARK UNIVERSITY. A. A. SCHRYVER.

VIII

Gray—"Manual of Botany." Blanchan—"Nature's Garden." Huntington—"Studies of Trees in Winter." Comstock—"Manual of Insects." Holland—"Butterfly Book" and "Moth Book."

Hodge—"Nature-Study and Life." Shaler—"Domesticated Animals." Blanchan—"Bird Neighbors." Chapman—"Bird-Life."

J. F. WHITE.

IX

Hodge—"Nature-Study and Life." Wright—"Flowers and Ferns in Their Haunts." Gibson—"Sharp Eyes;" "Eye Spy." Dickerson—"Moths and Butterflies." Comstock—"Insect Life." Blanchan—"Nature Garden." Creevey—"Flowers of Field, Wild and Swamp." Bailey—"Botany." Allen—"Flashlights of Nature." Miller—"The Brook Book."

Editor "Primary Education." EVA D. KELLOGG.

X

Hodge—"Nature-Study and Life." Saunders—"Insects Injurious to Fruits." Chapman—"Birds of Eastern North America." Agriculture Bulletins on moulds, mushrooms, and parasitic fungi. Green—"Elements of Forestry." Gray—"Manual of Botany." Gibson—"Sharp Eyes." Shaler—"Domesticated Animals." Brightwen—"Wild Nature Won by Kindness." There is no good book on general zoölogy, fishes, frogs, molluscs, and mammals.

CLARK UNIVERSITY. O. P. DELLINGER.

XI

I enclose such a list as I would give our own graduates, or more exactly, such a list as our graduates would be likely to make for themselves. I can give no order of preference for each book functions separately:

Hodge—"Nature-Study and Life." Keeler—"Our Native Trees." Blanchan—"Bird Neighbors." Comstock—"Insect Life." Blanchan—"Nature's Garden." Parsons—"How to know the Ferns." Ely—"A Woman's Hardy Garden." Hemenway—"How to make School Gardens." Clapp—"Thirty-six Observation Lessons on Common Minerals."

PHILADELPHIA NORMAL SCHOOL. L. L. WILSON.

XII

Bailey—"The Nature-Study Idea." Hodge—"Nature-Study and Life." James—"Talks to Teachers." White—"Natural History of Selborne." Jefferies—"The Life of the Fields." Thoreau "Walden." Burroughs—"A Year in the Fields." Gibson—"Sharp Eyes." Sharp—"Wild Life Near Home."

STAMFORD, CONN. E. F. BIGELOW.

XIII

Hodge—"Nature-Study and Life." Beal—"Seed Dispersal." Chapman—"Bird Life." Atkinson—"First Studies of Plant Life." Matthews—"Field Book of Wild Birds and their Music;" "Field Book of American Wild Flowers." Gibson—"My Study Neighbors;" "Sharp Eyes." Weed—"Nature Biographies." Jordan & Kellogg—"Animal Life."

BOYS' HIGH SCHOOL, BROOKLYN, N. Y. A. J. GROUT.

XIV

There are so many books on nature-study that it is rather difficult to choose ten which are absolutely the best. I shall divide them into two distinct groups—the first set including those suitable for primary readers:

Wilson—"Nature-Study in Elementary Schools." Nelson—"Second Science Reader." Beal—"Seed Dispersal." Needham—"Out-Door Study." Bamford—"My Land and Water Friends."

The second group for more advanced readers is as follows: Hodge—"Nature-Study and Life." Blanchan—"Nature's Garden;" "Bird Neighbors." Holland—"Butterfly Book." Marshall—"Mushroom Book." Of course there are a number of others which I consider almost if not quite as good as these. The many good leaflets from Hampton, Cornell, Minnesota and other institutions should not be ignored, as they are more or less valuable.

TUSKEGEE INSTITUTE. G. W. CARVER.

XV

I am sending a list of ten books which I find most valuable to me. You will understand, however, that my work is more largely school gardening work, and is closely connected with very practical nature-

study rather than that often taught in the public schools. For this reason my list may contain many books that others do not.

The Century Dictionary and Cyclopedia. Bailey—"Cyclopedia of American Horticulture." Hodge—"Nature-Study and Life." James—"Practical Agriculture." Goff—"Principles of Plant Culture." Voorhees—"First Principles of Agriculture." Miller—"Children's Gardens." Duncan—"Mary's Garden and How it Grew." Bailey—"The Nature-Study Idea." King—"Physics of Agriculture." Baldwin—"Industrial Social Education." Keeler—"Our Native Trees."

I find some of the bulletins published by the United States Department of Agriculture, and the different State agricultural experiment stations, the nature leaflets published at Hampton, Va., Cornell University, State Board of Education in Vermont, and a few of the leaflets published by some of the western agricultural experiment stations as valuable for reference as the books.

HARTFORD SCHOOL OF HORTICULTURE. H. D. HEMENWAY.

XVI

It is difficult to name a list of books which shall be better than any other list containing the same number. Among those that I have found helpful are as follows:

Abbott—"Days Outdoors" and his other works. Works of E. G. Ingersoll. Works of Thompson Seton. Coulter—"Plant Relations." Jordan & Kellogg—"Animal Life."

THE UNIVERSITY ELEMENTARY SCHOOL. W. S. JACKMAN.
CHICAGO.

XVII

Such books as Wright's Nature-Study Readers (which furnish both spirit and information) are in my opinion most useful to the ordinary teacher and pupil. Howe's "Elementary Science Teaching" is a most excellent book. Jackman's books are good if the teacher has the patience to find the useful points needed.

What is needed in my opinion is to avoid the extreme poetical and sentimental books and the routine book—not only routine in talking but routine in observation, like a book for laboratory observations on fruits and vegetables recently published.

SAM HOUSTON INSTITUTE, W. B. COLEMAN.
HUNTSVILLE, TEXAS.

XIX

The following we find helpful books for nature workers in California: Jenkins and Kellogg—"Lessons in Nature-Study." Hodge—"Nature Study and Life." Chandler—"Habits of California Plants." Grinnell—"Our Western Birds." Beal—"Seed Dispersal." Fairbanks—"Rocks and Minerals." Bamford—"Up and Down the Brooks." Conn—"Bacteria, Yeasts and Molds." Osterhout—"Experiments with Plants." Carter—"Nature Study with Common Things."

OAKLAND, CALIFORNIA. BERTHA CHAPMAN.

XX

Hodge—"Nature Study and Life." Bailey—"Cyclopedia of Horticulture." Howard—"Insect Book." Holland—"Butterfly Book." Blanchan—"Nature's Garden." Jordan and Evermann—"Food and Game Fishes." Goff—"Elementary Agriculture." Dugmore—"Bird Homes." Coulter—"Plants."

STATE NORMAL SCHOOL, ELLENSBURG, WASH. J. P. MUNSON.

XXI

For beginners in nature-study and for a general outlook on plant and animal life: Gaye—"The Great World's Farm." Jordan and Kellogg—"Animal Life." Atkinson—"First Studies of Plant Life." Blanchan—"Nature's Garden." Beal—"Seed Dispersal." Keeler—"Our Native Trees." Stone and Cram—"American Animals." Ingersoll—"Wild Neighbors." Burroughs—"Squirrels and Other Fur Bearers." Blanchan—"Bird Neighbors." Dickerson—"Moths and Butterflies." Needham—"Outdoor Studies."

(Letter not signed.)

XXII

I hesitate to send the list of the ten "best books" for teachers of nature-study. I find that very many teachers wish a book, or books, which will do the work, and let them (the teachers) ride in the parlor car.

I try very hard to impress upon all that the one essential is a lively

interest in some portion of nature-study, said interest being born of a real experience in and contact with nature. So I always try to turn them to books which will invite inquiry and thoughtful investigation, rather than to those which deal in "lessons."

I also seek to know the individual,or individuals, before I recommend books. In other words, I want the medicine to fit the ailment.

However, the following will show my general thought: Hodge—"Nature-Study and Life." Scott—"Nature Study and the Child." Comstock—"Insects." Orton—"Comparative Zoölogy." Bailey—"Lessons with Plants." Dana—"Our Wild Flowers." Chapman—"Bird Life." Dodge—"Reader of Physical Geography" (or better, "Elements of Geology" by Le Conte, if the teacher is equal to it). Jackman's—"Nature-Study."

This list can, of course, be extended almost indefinitely with books, some of which will be equally as good as the above.

DEPARTMENT OF EDUCATION,
CITY OF NEW YORK. D. L. BARDWELL.

TRUE NATURE-STUDY: ITS FUNDAMENTALS, AND ITS RELATION TO SOME OTHER SUBJECTS

BY I. V. CRONE

State Normal School, Greeley, Colo.

[Paper read before Science Section of Colorado State Teachers' Association, Dec. 1905.]

I. Introduction

The aim or purpose of education has been so fully agreed upon by educators that the statement of it has come to be a platitude; but in the foreword of this discussion I ask you to recall that aim—"the formation or development of right character."

Now if the formation or development of right character is the fundamental aim or end of education, and we are to try consciously so to regulate the machinery of education that there shall be the best possible results from the energy expended, it is of the utmost importance that we have and keep clearly in mind the forces that go to determine character; and these are two—environment and heredity. The character of an individual will at any time depend entirely upon these two factors, and the manner in which they react and have reacted in the presence of each other.

It is, of course, too late after the child has been born into the

world to change the sum-total of heredity; that is a fixed quantity and will always exert its influence in a line along which the individual will move forever unless acted upon by some other force. The only other force, or factor, which may exert its influences is, as before stated, environment; and the business of all education is concerned with placing the child in such environment,or placing such an environment about the child, as will, reacting upon heredity, result is the best development of character.

I need only call attention to the fact that through the process of evolution we have come up out of nature, of which we were once a part, to secure recognition of the fact that heredity is largely an inheritance from nature. The mind and soul of man, as well as his body, have their roots deep in nature-environment of the race during the millions of ages that are past. His habits are a result of the struggle for existence, which is and has been chiefly a struggle with natural environment; all his forms of expression, such as language and art, have drawn their elements from the sense-perceptions which nature impressed upon his evolving soul; and since natural environment has been so potent a factor in the past, it is fair to assume that it has in it the possibilities of great influence in the present.

As stated before, the function of education is to regulate the educational environment of the child; and the most important parts of that environment are, of course, the school, the teacher, and the course of study. The business of those having oversight of education is to fit the school, the course of study and the teacher to the heredity of the child in such a way that his educational environment may best act, with or against heredity, but always in the direction of right character.

The school should be in the midst of nature, the course of study should be firmly grounded in the things of nature; and the teacher should be able and willing to make use of nature constantly in forming the characters of the children placed in her charge.

II. The Fundamental Need

Need I say that of these three branches of educational environment, the most important is the teacher? I think not; for I believe all recognize the teacher as the one who, by her own activity and personality, must supply whatever is lacking from the school and the course of study that is potent in the development of character. She

must make herself supplement the school and course of study and make them fit the individual child.

My purpose is to emphasize in this paper the *fundamentals* of what I am pleased to term "true nature-study." And I am now brought to state its fundamental *need*. That need is competent teachers. Because of no other reason has nature-study been so handicapped as because of the lack of teachers to carry it on understandingly. I fear that this need will not be speedily supplied; for true nature-study teachers are rare, and a very little leaven must leaven a very large lump.

III. The Fundamental Aim

Like that of all other subjects in the course of study, the ultimate aim of nature-study must be the development of right character; but it is not sufficient so to state its aim. Character, like "Heaven, is not reached at a single bound; But we build the ladder on which we rise. * * * And we mount to its summit round by round." The accomplishment of the fundamental aim of nature-study furnishes one of the rounds in the educational ladder to character.

The aim of nature-study is sometimes stated to be the acquisition of information, of a large body of facts; this, unless related to a higher nature-study aim, is exceedingly narrow, but related to such an aim is of the greatest importance. Knowledge aids understanding, and understanding, sympathy.

Another insufficient aim is frequently stated, the development of the observational powers—the alert use of the senses. As a direct aim I consider this a failure. Some other motive must be given children. The developing of our bodies is never so powerful a motive for exercise as is something which we wish to do. The bird-dog's keen sense of smell did not come from trying to develop his nose, but from seeking the hiding partridge.

Another proposed aim is preparation for practical life. This aim finds great favor with many, and was never better expressed than by the farmer quoted by Bailey who said he wanted his boy to learn "more potato-bug and less pussy-willow." I shall have more to say regarding this in another place, but wish to state here that it seems to me to be widely separated from the fundamental aim of true nature-study.

Often other incomplete aims are stated; such as, to develop the

esthetic nature, to lay a foundation for geography or for literature, to give the first steps in scientific knowledge.

Thus we see that various people have proposed various aims for nature-study, and I believe its aims are various. Many of these are important, but I believe all are either subordinate or incidental to a higher aim, toward which the accomplishment of the others is only a series of progressive steps. *That aim is the developing and making permanent of a loving and sympathetic contact or fellowship with nature.* And if the intellect, feelings and will of the individual are in right relations with nature, great progress has been made in the formation of right character.

IV. The Source

Possibly no statement could be more truly axiomatic than that the fundamental source of subjects for nature-study should be nature herself, and not second-hand statements about, or representations of nature, such as are found in pictures and books, or as may be made by persons. Nevertheless I say with all confidence in the correctness of my view that more children, by far, are placed in the position of endeavoring to get their ideas of nature from books and from the statements of persons, especially teachers, than are taken or sent to nature or have nature brought to them, as a first hand source.

I wish to emphasize with all the force I can command that the chief, the fundamental, the pre-eminent source of nature-study should be nature herself. Not until the child has become acquainted with the object through his physical senses should he be set to reading about it in books, or made to listen to statements concerning it by his teacher.

I do not wish to be understood as under-rating the value of nature books, nor of vocal instruction by a good teacher; but these should follow, not precede, the first-hand contact with nature herself. It is only when there is in the child a mental concept of that part of nature which is being dealt with, that literature can be appreciated or the teacher's statements comprehended and understood.

Nature in her own haunts is the pre-eminent source; but there are supplemental sources which may be used to great advantage. Of these the museum is most closely allied to nature first-hand. Some of the second-hand sources that have great value, after first impressions have been made from nature herself, are statements made orally by persons and found in books, and representations made by pictures.

The competent teacher will make much use of these but she will never allow herself and school to be in the condition described by Agassiz when he said, "We study Nature from books and when we go where she is we cannot find her."

V. The Scope

I think any scientist, be he chemist, physicist, biologist, or geologist, would undertake eagerly to prove that among the various branches of science his own has at least equal importance with any other; yet experience, which certainly has come from efforts at nature-work in every field, seems to show that *the world of living things* is best adapted to have the child brought into that relation to it which is stated in our fundamental aim. Learned men recognize the unity of nature and hold reverence for all her parts; but such an attitude is the result of breadth of knowledge and depth of experience. Children are soonest reached by the animals and plants. They soonest and easiest, like

> "The poet, faithful and far-seeing,
> [See in *flowers and birds*] alike, a part
> Of the self-same, universal being
> That is throbbing in [their] brain and heart."

And while I believe there is material for nature-study in the stars and the rocks, the cloud and the brooklet, the sunset and the raging storm, I also believe that living things, the plants and the animals, should be the fundamental scope of the nature-study course. Not the animals and plants, either of another state or of far-away lands, but those in the immediate environment of the school and of the children's homes.

Nor must I leave the subject of the scope in nature-study without calling attention to the fundamental element of that scope. The activities and adaptations—the ecology—of the animal and plant are to be emphasized rather than structure and classification. Children need not know that the prairie-dog is a rodent; and they had far better watch it munch a grasshopper than learn that it possesses a notochord. They had far better sprout a seed than learn that the embryo therein is surrounded by an integument.

VI. The Method

I take it that method is the term used to designate the steps by which we try to accomplish the aim we set ourselves when we enter upon school work along any line. In the light of what has been said heretofore, we see that our method must be an attempt to bring the child into loving and sympathetic relationship with nature by first-hand attention to nature herself, especially in the world of plant and animal life.

Now it is axiomatic that first-hand study of nature requires that we go to nature in her own haunts. Reading in books will not do; class-room discussion will not do; pictures and museum specimens will not do. It is not usually feasible to bring nature into the schoolroom as the working plan, so the excursion to nature and the activity with nature is the ideal method, especially the excursion or activity by the teacher and pupils together. This method presents many difficulties of application; but I say emphatically that that teacher and school will most successfully attain the end of true nature-study which collectively or individually goes out to nature in her haunts, or engages in activities concerned with some of her forms. Watch a bird building its nest or feeding its young; note its bright colors; listen to its song; feed it in time of want; tame it if you can. Find the flower in its wild habitat; learn its name; observe it from season to season; try to grow it in your garden; protect it from ruthless harm. Employ intellect, feelings and will upon nature, and loving and sympathetic fellowship will result.

VII. Results

The accomplishment of our own aim in nature-study will have many important results, and it is well, I think, to call attention to some of these.

A fellowship with nature such as I have been talking about will give to the one possessing it a broader and deeper life than can be had by anyone who finds attractions only in man and in his works—in the artificialities of life.

It will lead many to choose country life who would otherwise go to the cities to find failure and eke out a miserable existence, unhealthy and unhappy, there.

It will furnish to many an avocation which will tend to keep them occupied and away from temptation and vice. The man who has

pets and a garden does not care so much for the club and the saloon.

The greatest idea in the world today is the idea of evolution. It is not conceivable that that idea can be clear without a thorough understanding of nature and her ways. No other idea may so warp character when misunderstood, or so strengthen it when well comprehended. Fellowship with nature is logical. Our blood and bone are filled with it. From it we get an idea of our origin and a hint of our destiny.

"The laws of Nature are the thoughts of God." "The heavens declare the glory of God and the firmament showeth His handiwork;" but

> "The works of God are fair for naught,
> Unless our eyes in seeing,
> See hidden in the thing the thought
> That animates its being."

Oh, how blind we are! God is everywhere: in the forms and activities of nature as well as in the hearts of His children. Who is to say but that fellowship with nature soonest leads to fellowship with Him?

VIII. Summary

I have attempted to show that the fundamental *source* of nature-study should be nature herself; the fundamental *scope* the world of living things; the fundamental *method* observations and activities based upon nature herself; and that *the fundamental aim* is to bring about a loving and sympathetic fellowship with nature, thus affecting character and supplementing education along other lines. It only remains to note the relation of true nature-study to some other subjects and I am through.

There are a number of subjects which are concerned with nature and some phase of each of which has been termed nature-study. One of these is elementary agriculture. Now I thoroughly believe that elementary agriculture is an important subject and deserves a large place in the elementary schools; yet the study of soils, their composition and fertility; of fertilizers and their effects upon plant growth; of insect pests as such; of the economic value of birds; of the varieties of fowls and the breeds of swine, are not true nature-study and should not be called by that name. However, much true nature-study can be done in connection with elementary agriculture.

The same thing may be said of both elementary horticulture and elementary forestry, each an important subject, but each having a different aim than that of nature-study.

Practically the same is also true of the school-garden, which is assuming much prominence as an educational factor, but which might just as properly be carried on under the head of manual training as of nature-study. Much nature-study might be done in connection with the school-garden, but much too little *is* done to entitle school-gardening to the name of nature-study. The nature-study ship must get free of some of its barnacles if it is to sail swiftly along toward the port of character.

The last subject I shall mention is elementary science and regarding it I wish to speak in no uncertain tone; for true nature study has suffered so much from no other one thing as from the scientific octopus, which has reached its —ology tentacles down into the common schools and crushed out of many a one of them the nature life that was promising so fair. To attempt to teach in the schools of the children the elements of university science and by the university scientific method, and do it under the name of nature-study, is as great a farce as was ever enacted upon the stage of education.

Science is cold, hard, exacting; nature is warm, responsive, inspiring; science is prose; nature is poetry. Science makes a scientist; nature-study makes a naturalist or a poet. Science finds in nature unyielding matter and fixed law; nature-study finds "tongues in trees; books in the running brooks; sermons in stones; and good in everything."

In justice to science and the scientists I wish to say that I do not underestimate their value and am not unmindful of the debt the world is owing them; neither am I unaware of the fact that the scientist is many times a lover of nature as well. But I am now protesting against that effort made in response to an awakened interest in nature in our public schools to lay the foundations of science there under the name and at the expense of nature study. True nature-study must ever say to science. "Thy ways are not my ways, nor thy thoughts my thoughts." Science is for the few, nature-study for all. They have but little in common. They should not conflict, but let them not be confused.

In conclusion I would say to all, "Go forth, under the open sky, and list to Nature's teachings."

INTRODUCING AGRICULTURAL INSTRUCTION INTO PUBLIC SCHOOLS

[Notes on Papers read before the Department of Nature-Study and Agriculture of the California Teachers' Association in joint session with State Farmers' Institute, December 26, 1905.]

The work of this section was inaugurated by an address by Dr. A. C. True, Director, Office of Experiment Stations, U. S. Dept. of Agriculture, Washington, D. C.

The discussion of the address was led by Prof. E. W. Hilgard, who pointed out some of the difficulties which must be overcome before agricultural instruction can be successfully undertaken in the public schools.

One serious obstacle is the lack of properly trained teachers for the work.

Another, the lack of contributing home influences among the people who would receive the immediate benefits of such instruction. Parents who have not received agricultural training have little realization of its value, and therefore look with little favor on its introduction into the already crowded courses of the public schools.

Under existing circumstances children are being educated away from the farm and something should be done to turn the tide back again into its natural channel. Any law compelling all teachers, whether prepared or not to teach agriculture must prove disastrous.

As a beginning, inducements should be offered to teachers to prepare themselves for the work of agricultural instruction and perhaps later it should be made a condition of certification of new teachers.

In the meantime much may be done by a few who, by reason of special agricultural training, are already available. Such could be employed as special visiting teachers in districts containing several schools, where there is an immediate demand for such work.

The earliest years of a child's life are marked by keenness of the perspective faculties, and it is during this time that the foundations of agricultural knowledge should be laid.

T. O. Crawford, Supt. Schools Alameda Co., continuing the discussion, advocated the teaching of agriculture both in the schools and in the homes. Recognizing the crowded condition of present courses of study, he advised the cutting out of useless 'work still

given in arithmetic, geography, physiology, etc., to make place for this line which is of so much greater importance.

L. D. Harvey, Supt. Stout Training Schools, Menomonie, Wis., said that children of the farms have a right to know their environment and to have the kind of instruction that is suited to their needs. This subject of agricultural instruction is "in the air." No one seems to have a very definite knowledge of what is needed and we therefore should make haste slowly, get preparation on the part of teachers and lay broad and deep the foundations of work that is of such far reaching importance, dealing as it does with the very basis of all industry.

The paper on school-gardens by Professor Davis was published in THE NATURE-STUDY REVIEW for March.

Another paper on school-gardens by A. J. Pillsbury contained the following points:

Manual training, whether in the form of school-gardens or Sloyd, rests upon principles of the most fundamental character. There isn't any wholesome or adequate development of the intellectual life apart from the development and training of the physical being. This is demonstrated in the homes for feeble-minded children as nowhere else. To be feeble-minded is not to be blank-minded. There is some element of mind there, and in all cases it is susceptible of some development, but there is no way of getting at it except through physical training, competitive play and manual training.

Therefore, apart from all considerations of learning how plants grow, apart from all value to be attributed to getting the child into touch with nature, and apart from all use that the knowledge of gardening may be to the child in after life, I favor the school-garden as an agency in intellectual development. From the cradle to the grave the powers for good that there are in us are drawn out through appeals to the physical senses. If further corroboration of this statement is required, the investigator will only have to visit the schools for the education of the blind and the deaf where, without manual training of some sort, these shut-in pupils remain shut-in until the grave closes over their solitary and melancholy lives. Per contra, as they are brought into touch with the physical world they are made useful, intelligent and happy, and in no other adequate way.

The life of the city child is shut in. To have eyes and ears and hands for which there is little use is almost as unfortunate as not to have them and deprives the brain of development in exact proportion

to the percentage of disuse. The school-garden and the Sloyd bench are aids in overcoming this shut-in condition.

The country boy and girl are forced to a greater degree of employment of the physical powers and therefore secure a greater degree of physical and mental development. The country boy or girl coming to the city may seem clownish and awkward. There are certain social conventionalisms that they have not learned, but send the city boy or girl to the country and then see which has the better use of the physical being, which responds most quickly and accurately to external stimuli. It was not by accident that the men who do the big business in cities, the men who lead in affairs, were born on farms. They were not only born, but developed there through the abounding activities of their physical beings.

Will the children take an interest in the school-gardens? They will if their instructor has enthusiasm. In teaching there is nothing without enthusiasm. If one doubts this let him see what drafts are made upon the patient enthusiasm of the teachers in schools for the feeble minded, without which there is no response, not even an answering echo, be it never so faint.

I have in mind a reform school in Massachusetts where there were 325 school-gardens just passing a fully realized consummation when I visited it last fall. There had been no flagging of enthusiasm along down the line from spring to late autumn. They had been revelations to the human sparrows gathered in from the cobblestones of Boston. I favor the school-gardens for city and town schools because city and town children need to learn how to handle themselves. I favor school-gardens for country schools because country children will need in their business the knowledge they will gain.

In the course of his address, President Wheeler of the University of California, expressed his interest and sympathy with the movement toward agricultural education. He was inclined, however, to be suspicious of those things for which there are general demands, and where those who make the demands do not know definitely what they want.

He expressed himself as having little faith in teaching science and scientific subjects in the public schools because of the lack of mental maturity of pupils in the grades.

He indicated the need of making a pedagogical concept of the work before attempting to teach it. The pupil should be brought into intelligent connection with the common things that surround him.

In conclusion he affirmed his faith that something will come of the effort now making in the direction of agricultural training in the public schools.

Mr. L. D. Harvey then addressed the section on "Experiments in Agricultural Education in This and Other Countries."

In the course of his address he showed that the attempt to give training in agriculture in the elementary schools had gradually ended in failure in this and other countries where tried. He indorsed what President Wheeler had said concerning the lack of definite ideas on the subject and characterized as foolish laws passed by some States making such instruction mandatory in all schools without regard for the unpreparedness of teachers.

Children of the public school have a right to education that will better fit them for their lives. He is inclined to urge training in agriculture because it would make rural people better able to earn a living, and because also of the cultural value which such training undoubtedly possesses.

In the light of the many mistakes that have been made along this line he urged extreme caution, however. He referred to the Cornell movement as one which was not an unqualified success and said that in practice it was found that the children most interested in the work sent out were the children of the better city schools rather than those who lived on the farms. He expressed the opinion that not much is to be expected from pupils of the age of those attending the rural schools. He detailed attempts made along this line in Canada, Ireland, Belgium, and the Scandinavian countries and told of the discouraging results reached. The results have generally been better in the secondary schools, and incidents were cited to show this. Secondary schools in rural districts (county high schools) are the real schools from which we may reasonably expect results commensurate with the efforts and expense put forth.

He dwelt at length upon a school in Wisconsin which gave courses in agriculture, manual training, and domestic ecomony, and in which the work had been made of direct value to the farmers of the surrounding region, thus gaining their warm support by leading them to see its practical utility. In conclusion he urged that in seeking agricultural education we must seek for definite things that are useful.

The discussion of Mr. Harvey's address was led by Dr. True who said in part: "There must be in all matters of this kind a period of

agitation—not always intelligent. Here this phase is passing into that of examination by educational people and withal an attempt to formulate the conditions under which such instruction shall be given, as well as the subject matter to be included.

"I agree with all of those who have spoken that whatever is done should be done cautiously, thus avoiding the fatal mistakes so apt to be experienced in such a movement.

"I also agree with those who oppose mandatory legislation to introduce agricultural instruction into all the schools of any state. But I do believe that in some schools, with some teachers, such work in elementary agriculture can be profitably undertaken. Some excellent text-books are already out and more will undoubtedly come in response to a demand for them. The texts should be such as will interest parents as well as pupils."

Dr. True expressed the belief that school-garden work offers peculiar advantages for elementary work. [Excerpt from *Western Journal of Education*, March, 1906.]

NOTES FROM SCHOOLS

College Science Transferred to Nature-Study. A teacher in an eastern school was recently criticized because she was giving too much advanced science to her nature-study and geography classes. She replied in all seriousness that she had spent time, energy and money in summer sessions of prominent colleges and that she thought she ought to use the knowledge gained by giving it to her pupils Perhaps it is the fear of letting good knowledge go to waste that leads so many teachers to attempt pouring somewhat diluted science courses into elementary-school pupils.

Agriculture in Normal Schools. No one can graduate from the Wisconsin normal schools without taking a course in elementary agriculture. Furthermore, there are several county training schools whose particular function is to teach agriculture to teachers of country schools.

Pupils' Knowledge of Names of Plants and Animals. A recent lesson in a fifth grade of a New York City school in the district known as Manhattanville brought out the following facts as to pupils' familiarity with names of common plants and animals. It was not a test in identification,

but simply an attempt to find out what common names were in the pupils' memory and recalled within thirty minutes. Considering that most of the children came from homes where there can be little contract with nature, the results given below were doubly interesting to me and to others who read them.

Names of trees known: one pupil knew 5, one 17, average for 16 children 9. Names of wild flowers: one pupil 4, one 15, average 8. Names of cultivated plants: one 3, one 15, average 10.

Twenty-six species of trees were named; the best known being oak (14 pupils), pear (13), maple (14), peach (12), apple (14), cherry (16).

Twenty-eight species of wild flowers; the best known being daisy (15), violet (14), dandelion (12), wild rose (10), butter-cup (8), jack-in-pulpit (10).

Thirty-one cultivated plants; the best known being pansy (14), geranium (13), lilac (13), cactus (9), morning glory (12), forget-me-not (9).

GRACE L. MORRISON.

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NATURE NOTES

Telephoning at Sea. Ocean liners may now be warned of a dangerous coast by telephone. A submerged bell located on a rock or other point of danger sends its sound through the water to the ship's hull where it is received. Attached to the inner plating of the vessel is a microphone contained in a tank of liquid. By means of a telephone placed in circuit with the microphone, signals have been received on board ship from a ringing bell eight miles distant. To dissipate local noises on the steamer some liquid heavier than water is used, as brine. Several large vessels of the German, British, and American lines have already adopted the system. (March *Forum*)

Steel from Sand. Dr. David Gray, a government expert, has shown that good steel can be made from a common black sand found on the Pacific Coast, and some samples of the sand have produced six hundred and forty-four pounds of magnetic iron to the ton. Among other minerals he has found gold and tantalum. The latter substance he expects to see in use as a filament material for incandescent lights, as it is capable of producing twice

the light now obtained with one half the present expenditure of power. (*World's Work*, March).

Mining Sulphur by Hot Water. Louisiana has large sulphur beds deposited under a most difficult quicksand. Formerly these could only be worked at an enormous expense by freezing the quicksand or sinking a metal-lined shaft. The problem of recovering this sulphur at a reasonable cost has been solved. Through a ten inch pipe, hot water at a temperature of 240° F. is sent down to the sulphur beds; through a second pipe within the main one, the liquid sulphur, melted by the hot water, is pushed up partly by the weight of descending water and partly by compressed air. As one thousand tons of sulphur may now be obtained in one day by this process Louisiana has become a formidable rival to Sicily in the sulphur industry. (March *Forum*).

Pulp-wood. According to statistics collected by the U. S. Forest Service, in the manufacture of pulp for paper 232 mills used over 3,000,000 cords of wood in 1905, chiefly spruce, poplar, hemlock and pine. There has been an increase of over 50 per cent in the last six years. Evidently the pulp industry is a great drain on American forests.

Wood in Box-Making. In 1905 less than 300 box factories in New England used over 600 million feet of lumber, (in round numbers 490 million white pine, 60 million spruce, 25 million hemlock, and all other woods 25 million). The value of the rough lumber delivered at the factories was nearly $9,000,000. (From *Press Bulletin* of U. S. Forest Service).

Aigrettes Unlawful. According to a recent decision of the Court of Appeals, State of New York, it is unlawful to have in possession the dead bodies of certain birds, similar to New York species, even though received from Europe. The President of the National Association of Audubon Societies points out that selling or having in possession the plumage of herons, sold under the trade name of "aigrettes" is unlawful under this decision supporting the constitutionality of the law. For the full decision of the Court see *Bird Lore*, Vol. 8, p. 74, April, 1906.

Cabbage Hair-Worm. This animal, also called cabbage snake, was found in heads of cabbage in various states two years ago, and wild rumors of its deadly poisonous nature were circulated by the ever irresponsible yellow newspapers and caused great public alarm and great loss to the growers of cabbage. Circular 62 of the Bureau of Entomology states that the worm is *entirely harmless* and not a trace of poison can be detected by the most careful experimenters. It is a true hair-worm, closely related to the famous horse-hair worm (Gordius.) Its size is about that of a No. 40 thread and

rarely more than eight or nine inches long, usually two or three inches. The early stages of its life-history are passed in the bodies of insects, and when fully developed they emerge and conceal themselves in the ground. Their occurrence in cabbage heads is probably simple concealment, and they in no way harm the plant.

Arbor Day. Twenty-five hundred copies of a pamphlet on Arbor Day were printed this year by the State Board of Agriculture of Massachusetts and mailed to schools, with the request that the day (April 28) would be given some observance by teachers of nature-study and sciences. The pamphlet contains papers on selection of woody plants for school-grounds, how birds effect trees, on certain insect enemies, and on the meaning of Arbor Day. Those interested should write to the Secretary of Agriculture, Boston, and apply for a copy.

NEWS NOTES

Nature-Study in Summer Schools. Information has reached the office of this journal that the following institutions will give special attention to nature-study, most of them also including school-gardens and elementary-school agriculture; Cornell University, Ithaca, N. Y., Columbia University, New York City; University of Chicago; N. C. College of Agriculture, Raleigh, N. C. (Prof. F. L. Stevens in charge of agriculture and Mrs. Stevens in nature-study;) Woodland Farm Camp School, Westchester, Conn. (Mr. H. D. Hemenway, of Hartford, instructor in nature-study); Connecticut Chautauqua, Forestville, Conn., July 12 to 27 (Dr. W. N. Clute, Editor *American Botanist*, in charge of nature-study); Illinois State Normal, Normal, Ill., June 5 to July 20 (Prof. J. P. Stewart in charge of nature-study). According to the advertisements in various educational journals, most of the leading normal schools will have summer sessions.

Courses in sciences are to be given at Cornell, Columbia, Chicago, Harvard, Michigan and at many state colleges. Special summer courses in biology at Wood's Hole, Mass., and Cold Spring Harbor, Long Island.

Advertisements of some of these schools named above are printed on other pages of this magazine. Most of them open early in July and close about the middle of August. To obtain more detailed information write at once to secretaries of any institutions named above.

Audubon. This name was misspelled with o instead of the second u on page 149 of the last issue.

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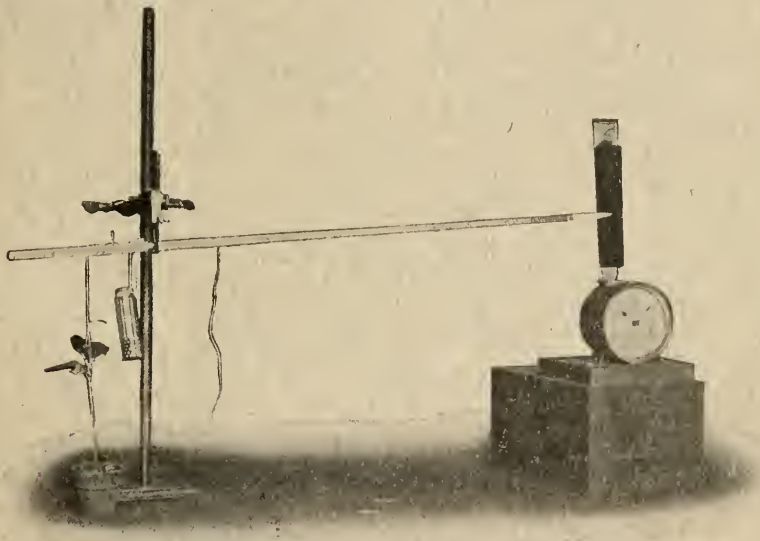

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THE NATURE-STUDY REVIEW

Vol. 2, No. 6
WHOLE NO. 12

September, 1906

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

CONTENTS

	PAGE
Nature-Study and High-School Chemistry. ALEXANDER SMITH	193
Snails for Nature-Study. M. A. BIGELOW	198
Study of Snail in Fourth or Fifth Grades. ANNA N. BIGELOW	201
Gardens for City Schools. H. G. PARSONS	204
Colors of Butterflies and Moths. V. L. KELLOGG	206
Canadian Department. Edited by W. LOCHHEAD	211
Discussion and Correspondence: Best Books for Nature-Study	212
Organization of Natural History Club. H. M. BENEDICT	216
Book Reviews	218
Nature-Study and Science Notes	220
News Notes	224

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THE
NATURE-STUDY REVIEW

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

VOL. 2 SEPTEMBER, 1906 NO. 6

NATURE-STUDY AND HIGH-SCHOOL CHEMISTRY

BY ALEXANDER SMITH

Professor of Chemistry, The University of Chicago

[EDITORIAL NOTE.—Most articles heretofore published in THE REVIEW have discussed nature-study from the standpoint of elementary education considered as complete in itself and with only incidental regard for the bearings of nature-study on high-school sciences. However, the secondary schools do have great interest in the nature-study which precedes their own work, and something may be gained by looking at nature-study problems from the high-school point of view. The paper before us is full of suggestions concerning physical nature-study for elementary schools which will be valuable quite apart from preparation for high-school chemistry, in which the author is specially interested.]

That some study of natural objects and processes is an indispensable part of elementary education nearly all concede. It must be admitted, however, that the problem of how to manage this part of the instruction is an exceedingly difficult one and is still far from having been solved. Those who have little scientific training are naturally hampered in their efforts to suggest means of accomplishing the end in view by their lack of knowledge, and those who are trained in some of the sciences are, if possible, still more embarrassed by the highly organized and differentiated nature of the knowledge they possess and by the difficulty they therefore experience in adjusting themselves to the entirely novel way of arranging the study of their subject which the case demands. One difficulty is that when we attempt to describe what the work should be our description is itself more or less conventionally organized and systematic, and is thus in danger of impressing upon the resulting instruction the very qualities that should most carefully be eliminated.

It is not part of my purpose to treat this question exhaustively, or to present an outline of my own. That would demand much more

space than is available and far greater experience than I can claim. Even if this were done, however, chemistry, as such, would play a very small part. Biological questions have on the whole the greatest native interest for young children and physical questions are far simpler and more commonly encountered than are chemical ones. At the same time, the teacher in the secondary-school, whose viewpoint we are chiefly considering, has a vital interest in the work of the grades, upon which his instruction is to be superimposed. The high-school teacher of chemistry, in particular, is in fact dependent for the measure of his success largely on the existence in the minds of his pupils of a pre-disposition to experimental inquiry and of a general knowledge of the properties of matter. He can afford to dispense with a previous knowledge of chemistry, but the absence of a general appreciation of matters ordinarily classed as scientific and of some slight capacity to study things inductively must hopelessly impede his progress. While he will not demand the teaching of chemistry in the grades, he will therefore vigorously contend for nature-study on rational lines as an integral part of the instruction in every year of the lower schools and as a preparation for his own work. He will hope also that as much of this as possible will be experimental.

The nature and function of this nature-study is well described by the Committee on Entrance Requirements of the National Educational Association (1899), as follows:

"To keep the 'tentacles of inquiry' functional, if not to develop them, at least two exercises in nature study each week should be provided throughout the entire pre-high-school period. Numerous sciences should be made to contribute a great variety of material, and no science should be presented in an organized form. The most available material should be selected, without any reference to scientific sequence. The material should be obvious (entering into the experience of the pupils), important and interesting. It should be deliberately varied and fragmentary, and should result in that miscellaneous collection of impressions which comes to an untrained but interested observer, without any definite organization. The knowledge of the wide-awake country boy who lives out-of-doors is probably the best illustration of the kind of knowledge nature-study is expected to bring—a magnificent background of experience for the formal organization of the sciences in secondary-school and college courses.

To preserve alive the "tentacles of inquiry" amid the deadening influence of much book-study of other subjects and to give some first-

hand knowledge of common things seem to be ends difficult of accomplishment. At least if we take the product of the schools as a whole, their attainments in the latter direction, for example, are woefully small. The present prodigious ignorance of many school and even college pupils of the simplest qualities of familiar materials is positively startling, even to those who have frequent occasion to encounter it. If the lower schools, to use the words of the Committee of Nine,[1] could "train children to see, to think, to talk, to write, or, in more general terms, first to get knowledge by thoughtful observation of real things, and then to express it naturally and correctly," a task which would not seem to be beyond their scope or powers, they would elevate their pupils to a plane upon which much better advantage could be taken of the instruction offered in the secondary-schools. As yet this work has not been recognized as constituting part of the regular course of every school and it is given with success only in a few cases where the teachers happen to be especially interested in nature work.

The material selected for nature-study should be "obvious (entering into the experience of the pupil), important and interesting." The initial step should be from the child's own interest. If a starting point of this kind can be found, much more real good can be accomplished than by any schematically prearranged outline of work. For example, some of the children observe the excavation for the basement of a new building near the school and notice that below the sand there is a layer of blue clay. It occurs to them to ask the teacher whether plants would grow in that as they do in ordinary soil. At her suggestion they get some empty tomato cans, fill them with sand, clay, gravel, and black soil respectively, and plant seeds in each, in order to find out for themselves the answer to their own question. Other experiments in response to other questions may follow naturally and a good deal of knowledge be gained without anyone having realized that this was study at all. The period spent in making and discussing experiments like these will be the most popular of the day and the eagerness of the pupils to see how the experiments are progressing will give the teacher an opportunity ready-made which her utmost efforts could hardly call forth in connection with arithmetic or English.

Although the work should never be without plan, the same enthu-

[1] Committee of Nine of the New York State Science Teachers Assn. (1895).

siasm cannot be aroused, or the same results attained with a more schematic plan than that indicated by the foregoing illustration, or with any organized system of object study. The abstract treatment of the properties of some material will not in itself sustain the interest of children, nor will the study of isolated materials, plants or animals, hold the attention. To quote Miss Camp:[2]

"This so-called 'object-study' conceives the presence of a material, such as chalk, stone or wood, in the child's immediate surroundings to be sufficient justification for its detailed study. A child accustomed to taking a purely sensational interest in natural objects will soon lose his natural attitude of investigation and inquiry. On the other hand, by the reinforcement brought to observation of natural phenomena through their connection with some use, either by the child or by man, not only is the habit of inquiry more firmly established, but incidental observations are made the child's permanent property. Because a child is using wood in construction is no reason for giving him, when the properties taken up have no connection with his use of the material, such detailed observations as the number and position of the knots, the grain of the board as depending on the section of the tree, etc. . . . . The same objection applies to the detailed study of any process isolated from its social value. For example, the city child must be quite well advanced, and have a background of social acquaintance with agriculture and navigation to appreciate the importance and immediate effect of meteorological conditions."

An organized scientific form of arrangement is the bane of nature-study. There can be no biology or chemistry for young pupils. There is simply the problem, and, like all problems in science, it will run naturally into the field of more than one of the sciences before it has been solved. For example, Jackman[3] has suggested the problems of the destiny of autumn leaves as a subject of interest to children, and as being capable of experimental study. Mixed problems like this and the soil question referred to above, are numerous, purely chemical ones are not. It is useless to take some of the chief chapters from text-books on the science and give them in emasculated form to children. Appreciation of the fact that common materials may be resolved into elements, which may be classified as metals or non-metals, requires too great powers of abstraction, although I have seen this included in one very brief list of topics for grade work. Nor was the caption "Acids, bases, salts" in the same list any more fortunate.

The combustion of a candle, the source of the light and the

[2] *The Elementary School Record* (1900) No. 6.

[3] "Nature-Study for Grammar Grades," Chap. VIII.

relation to air and to carbon dioxide are examples of subjects suitable for study. The questions raised are chemical, with a large admixture of physics. Making illuminating gas and coke by heating coal in a clay-pipe and other experiments clustering round this are instructive, although most illuminating gas is not made from coal nowadays. Baking powder and fermentation are subjects which have been used with success. In all cases study must be restricted to the simpler facts. If sugar were the topic, to show that it contains carbon, hydrogen and oxygen would be perhaps the first experiment that would occur to the trained chemist, and yet this should be the very last to be used with a child. The chemist classifies the substance in consequence of its composition. But in ordinary experience sugar on the one hand and carbon, hydrogen, and oxygen on the other are totally foreign materials. The things described by the last three names and their properties are not observable in sugar or in connection with it. It is not until we burn our sugar in making candy that the carbon in it becomes significant. I do not say that the study of the composition of compounds is not often a matter for elementary pupils to know. It introduces a characteristically adult and scientific way of classifying and describing, however, which often sets at defiance common experience. It brings forth the most mysterious facts of the science instead of the simplest, and should therefore be used sparingly.

In the foregoing remarks experimental work by the pupil has been sufficiently insisted upon. It is not less important in the grammar school than in the secondary school. Very simple materials will almost always suffice. Often the pupils will be induced to try the experiments at home. Thus the comparison of the weights of ordinary and of dried leaves, the making of coke, etc., can be done outside the school.

The difficulty in getting teachers trained to give work like this is perhaps the greatest we have to meet. The grade teacher either knows nothing of science, or her knowledge is of the conventional type which does as much harm as good. Still, in the opinion of many, much may be done by the principal giving the necessary instruction to the teachers or by the appointment of a special supervisor to organize the work in several schools. In large cities the employment of special teachers, who go from school to school has been found to work well in England. This plan is already in successful operation in the cases of drawing and music.

The benefits of nature-study of the right kind are well described in the closing paragraph of Miss Camp's paper:

"If during these nine years the child has attained to some skill and readiness in the use of the experimental method of inquiry; has a general conception of the dependence of the various forms of life upon each other and upon the inorganic world; has had his general interest in what is happening developed into an interest in how the thing happens; and, together with this ready use of experimentation and observation, has learned the use of books as sources, not only of information, but also of the condensed conclusions of other men's observations, he will be ready for the more specialized work of the secondary period. He will be in no danger of assuming too soon and too rigidly the attitude of the specialist. He will be able to choose the point of view from which to regard any set of natural conditions, for instance geological or biological, without shutting out the interaction of one field of observation upon others. The machine with which he performs experiments in the physical laboratory will never be to him, as it is now to many, a unique and isolated invention of the laboratory, but will find its place as a means of analysis of all the various forms of machines in use about him. His interest in nature will never be that of the collector pure and simple, but that of the scientific naturalist whose collections have some specific and definite aim.

If the use of experimental and observational science can accomplish this training of the constructive and inquiring mind, it will have justified its place in a plan of elementary education."

SNAILS FOR NATURE-STUDY

BY MAURICE A. BIGELOW

Teachers College, Columbia University

Snails are not commonly included in the list of animals available for nature-study observations in elementary schools, and the chief reason is that representatives of our numerous American species of snails are not easily obtained in numbers needed for class work. Moreover, our species are comparatively small and not easy to study by one making his first observations on snails.

These objections to the study of snails may be overcome by the use of the European edible snail (Helix pomatia). There is no animal which is at once so easily obtained in any number, so easily kept in the schoolroom, and so full of interesting surprises to the young

pupils whose ideas of animals are based on vertebrates and arthropods (crayfish, spiders insects, centipedes), which are the most common forms seen in our schoolrooms. For these reasons I want to urge that the edible snail should become better known to teachers and used as a means of introducing our pupils to its American cousins and more distant relatives in the snail group. These snails are now regularly imported from France and Germany where they are common pests in gardens, and may be found in the provision markets of our large cities during the cooler months, from about October 15 to April 1. They are brought from Europe in the dormant or winter condition, the aperture of the shell being sealed by the temporary plate (epiphragm) of calcified mucus. In this condition they may be packed, shipped and stored for months in dry sawdust or "excelsior." The snails may be purchased in autumn and the stock kept in some cool and dry place until they are wanted for class study, perhaps in late spring. When active snails are needed it is only necessary to put them in a warm, wet place on grassy sod, moss, sand or sawdust; and under the influence of the moisture the epiphragm soon softens and the head and foot emerge from the shell. The emergence may be hastened by first removing the epiphragm with the point of a knife before placing the animals on a wet surface. Dipping for only a moment into lukewarm water will also hasten emergence from the winter quarters.

I have written above "cool and dry." In the warm schoolroom some of the sealed snails will die and dry out if kept all winter, but they may be left on the tables for several weeks without any attention and when wanted in active condition treated as described above. Could a more convenient animal be wanted?

The active snails may be kept so for months in a simple vivarium which consists of a shallow box or bucket covered with coarse wire-netting and having the bottom covered with grassy sod or coarse sand or gravel. I prefer the gravel because it may be washed in running water occasionally, which is desirable in case the vivarium is kept in the schoolroom.

The snails will eat lettuce, cabbage, celery, parsley and other green vegetables. They seem to prefer the food given them first when they emerge from winter quarters. The most convenient way to handle the living snail in the class-room is to allow it to crawl on a plate of glass to which the foot soon firmly adheres, making it possible to hold the glass in any position. All external parts and movements are then

easily seen from any desired point of view. Lettuce leaves may be placed near the mouth and the process of feeding observed through the glass; and in the same way the remarkable muscular movements of the foot may be seen. If the snails are sluggish when wanted for class study, stimulate them by quickly dipping into *lukewarm* water, but take care to hold them with breathing aperture (see description in later paragraph) down so that the water may be drained from the "lungs." The land-snails have become adapted to breathing air and may be drowned like any other animal with lungs.

These snails are best killed for anatomical study in colleges and for museum preparations by drowning. Boil water to expel the air and keep tightly covered until cooled. Then fill a jar completely with water, put in the snails, cover tightly, and after about thirty hours they will be found more or less stupefied in an expanded condition. Select those which are quite stupefied and place them one by one in water heated as hot as your hand will bear, quickly smooth out wrinkles in the foot, press upon the bases of tentacles to extend them, and having arranged the parts as natural as possible, drop the animal into formaline five parts in 100 parts water. With a little practice 80 per cent. of the snails can be killed and hardened in a very life-like condition of expansion. After hardening for a few days in the formaline, the visceral mass of some individuals may be easily twisted out of the shell, but usually the columellar muscle clings so firmly that it is necessary to chip the shell into pieces with forceps in order to remove it. The specimens may be preserved indefinitely in the formaline solution. Specimens with the shell about half chipped away are valuable for showing where the body of the animal is located.

How to Obtain the Edible Snails

In order to have many trials of this interesting snail and to get reports from teachers, THE NATURE-STUDY REVIEW has arranged to supply limited numbers of dormant specimens to subscribers at actual cost of snails, packing and shipping four cents each (send 1 and 2 cent stamps). If you want one hundred or more, they may be purchased at $1.25 to $1.50 per 100, expressage collect, from C. Perceval, dealer in table delicacies, 100 Sixth Avenue, New York. Probably the Shawmut Market Co. State and Lake Streets, Chicago, can supply them by the hundred in season, but the price will necessarily be higher in western cities.

STUDY OF LAND-SNAIL IN THE FOURTH OR FIFTH GRADES

BY ANNA N. BIGELOW

Miss Chapin's School for Girls, New York

What is the land-snail good for?

The writer is well aware that certain critics of nature-study urge that the first consideration in planning a nature-study lesson should be the "human interest" based on what the animal is good for. However, experience with many classes of children of various ages forces the conviction that in the case of many interesting, but not very useful animals, the interest and enthusiasm requires no arbitrary pedagogical method of procedure. The real human interest in this case is the child's natural interest in pet animals, and this is here the best guide. Experience shows that all the following points are interesting, and valuable—in almost any order of study—(a) in developing the child's sympathetic attitude towards animals and (b) in training in the method of scientific study. It matters little, then, where the teacher mentions such economic facts as that the snail is edible and destructive to gardens (see preceeding article). These excite little interest as compared with that stimulated by considering the animal as a representative of a great group and because of its own interesting "personality."

I. Snail in Winter-Quarters

(In this condition they are brought from Europe.)

Note that the mouth of the shell is completely closed by a plaster plate. Notice the shape of the shell—a spiral (make a spiral from paper or wire). The small end (the apex) represents the beginning of the snail's shell, while the large whorl ending at the mouth is the newest part of the shell. Hold the shell with the mouth toward you and the apex up and notice that the opening of the shell is to your right. Such a shell is called a right-handed shell. Later you may see some species of snails having a spiral turning to the left and such are therefore known as left-handed shells. Examination of some empty snail shells, some chipped on one side to show internal structure, will be interesting. Notice the central column around

which the spiral is turned. At this point make a drawing of a snail in winter quarters. Place the shell with apex up and the mouth toward you and in this position all the important structure can be brought into one sketch.

At the close of the above lesson, have ready tumblers containing a half inch of fine gravel or sand and enough water to keep the gravel wet. Into each of these place a snail and then cover, leaving just a little air space. The children are to keep these dishes under observation until the snails become active. Then begin the next lesson by having the children tell just what the snail looked like in winter quarters, what they did with them and what has happened to the snail since their last lesson. Just what was necessary to loosen the plaster plate? (In their natural homes the snail goes into winter quarters in autumn when the soil becomes cold or dry, and when spring returns with its warmth and moisture the little plaster plate drops out just as it did in the schoolroom and the animal begins to hunt for something to eat. The door forms an efficient protection against dryness and insects or other enemies. Snails have been known to remain in their dormant condition for upwards of six years.)

Take a dormant snail, pry off the plaster plate with a knife. One or more transparent films (curtains) may then be seen. After removing these, notice how the animal is tucked away in its shell. Usually only the yellow collar, to be described later, is seen; and a large hole (for breathing) is visible on the right side. If these structures are not seen clearly at this point there will be plenty of opportunity to see them later when some active animal withdraws within its shell to rest.

II. Study of the Snail in its Active Condition

Each child (or, if necessary, groups of three or four) should have a piece of glass at least 4x5 inches. Old photographic negatives may be cleaned with hot water and washing soda. Place the snail on a glass plate and it will soon begin to crawl.

Place a bit of lettuce before the snail and do not touch or jar the animal. If not disturbed, it will crawl to the lettuce and begin to feed, being very hungry, not having had food since last summer.

Notice on the end of the head are two pairs of soft, flexible organs (feelers). The upper and larger ones bear at their ends each a tiny black dot (eye). Do you see eyes on the shorter, lower feelers?

Now observe the manner in which the feelers are put out and drawn in. The tip is always the last to come out and the first to be drawn in. The process of withdrawing the feelers can be illustrated by fastening threads to the tip of a glove-finger both inside and outside and then pulling on the strings to cause withdrawal and protrusion.

Observe how the snail makes use of its feelers in moving from place to place and in detecting the presence of food. Bring a pencil near the feeler and notice if the snail responds. Does the animal seem to see? Also how does it respond when the feeler is touched lightly? What good are the feelers to the snail? Do they assist the snail in taking care of itself? Note the transparency of the feelers (sometimes the eye can be followed even to the base of the feeler as it is being inverted.

Find the mouth (this can be seen very well if the glass is turned over; the snail will not fall off). There are two side lips and one small lower lip. When feeding so that the mouth is open, the crescentic row of little brownish, comb-like teeth can be seen. The floor of the mouth is covered with rows of tiny little teeth.

Watch the snail eat. Examine a little of the partly eaten lettuce which shows the teeth marks. Listen while the animal eats and you will hear a rasping sound.

The broad expanded fleshy portion which adheres so firmly to the glass is the foot. Watch the foot from the under side while the animal is crawling over the glass, and see the waves which are passing over the foot. The motion is the result of a series of contractions in the muscles of the foot. Watch the animal crawling about in various positions and note how the shell is carried.

How much of the animal comes out of the shell? (The head and foot are the only parts that ever protrude from the shell. A museum specimen with shell partly removed will show just what part is always within the shell. In such a museum specimen, notice that the parts which can be protruded are leathery, while the parts protected by the shell are covered with a skin so thin that all the inside of the snail can be easily seen through).

Feel the skin, note that it is soft and moist with a slime. Trails of this slime can be seen on the glass plates. A similar slime together with some lime which the animal gets from its food are the materials which make the shell. The slime hardens quickly and can often be seen, forming a covering to the snail when at rest or when the atmosphere of its vivarium becomes too dry.

Just inside the lip of the shell and lining the whole edge of the shell's mouth is the yellow collar; it is this part of the snail which makes the shell. The shell is made larger by the addition of layers to the edge of the mouth, consequently the lines of growth (which show on the outside of the snail shell) are always parallel to the lip of the shell. When the animal withdraws into the shell, the collar covers the animal and hides it from view.

When the animal is crawling about look under the right side of its shell and note the hole in the yellow collar. This is the breathing hole and leads into a large air sack, the lungs of the snail. If this hole be watched for a few minutes, it will be seen to open and close. Look for the breathing hole in a snail which has withdrawn into its shell.

The children should make sketches of the active snail in various positions and label all parts. Try modelling in clay. Descriptions in writing should accompany the drawings.

GARDENS FOR CITY SCHOOLS

BY HENRY GRISCOM PARSONS

Assistant Director of Children's School Farm, DeWitt Clinton Park, New York City

What can be done with a small garden connected with a school of 1500 children in a city?

Such a proposition was recently given me. The garden was inspected and found to be fifty feet long and about ten feet wide on either side of the stone walk. The soil was good but shallow, with perhaps four to eight hours sun on clear days. A volunteer crop of much maligned plants, commonly called weeds, had taken it upon themselves to accompany some manure to the garden and had already started up a fine growth. In a few square feet were found burdock, yellowdock, plantain, dandelion, several wild grasses, wild strawberry and chickweed. So the first suggestion was a wild plant section where these friends should have first chance. The farmer seriously objects to the many weeds which often come to his fields with the manure; in this garden instead of being obnoxious, they are just what is wanted for nature-study

Among the wild plants suggested to be added are Jack-in-the-pulpit,

mullen, tansy, wild carrot, caraway, butter and-eggs, milkweed, purslane, indian pipe, wild geranium, buttercup, white daisy, hepatica, dog-tooth violet, dutchman's breeches, etc., to be brought in from time to time from trips afield. Next to these some tame plants of economic importance; a single row each of grain, rye, wheat, barley, oats, buckwheat; a few easily grown vegetables like beets, lettuce, radish and peas. A hundred square feet left to the kindergarten class was only slightly encroached on for a dozen sun-flowers along the wall. All of this to be on one side of the center path; the opposite side to be given up to flowers, perennial and annual. At the wall ivy, morning glory, scarlet runner, and other vines; at the shady end lily-of-the-valley and star-of-Bethlehem; at the sunniest end roses. Hyacinths were already blooming beautifully from bulbs set the previous fall. The path may be bordered by a narrow matted row of low growing flowers like dandelion, sweet alyssum, pansies, portulacca, heliotrope, etc.

Once the garden is well started, children and teachers will think of it when they find plants growing wild under conditions similar to those of their garden and will bring specimens to try there. Where there is but little sun in the garden, woodland conditions can be imitated: where there is much sun, bring plants from the open field: where the ground is shallow only attempt shallow rooted plants. Horse manure from the street sweepings can be easily obtained to keep the soil rich, and can be added from time to time through the late fall and winter *but not after spring begins*. There should be one person to have general supervision of the garden, with an ideal to be worked up to. Often the janitor will become, or is already enthusiastic and able to care for it. Such a man must be restrained a little so as to remember that it is the school's garden, or he will grow only what pleases him. Among the older girls or boys there will always be plenty to do the little necessary work if it is divided among them properly and they are guided while doing it. Nature-study classes should keep records of the plants tried in the garden, noting the successes and failures, so that the work will be progressive and gradually there will be more successes than failures. Let the "Why" of what goes on in the different ways plants grow remain quiescent until the "How" is slightly mastered. When the garden is filled with successfully growing things will be time for the "Whys" to come up for study. If we cannot take the whole school to the fields we can bring many of the field plants to the garden. Efforts should not

be wasted on plants which demand "just so" conditions. Bring and make love to such as have to battle for existence in the fields or woods for many generations. Relieve them of the fierce competition and they will reward you with marvelous growth. Teachers who hesitate from lack of knowledge to conduct such a garden, will find the head gardeners in our parks usually very willing to give desired information of plants and their habits of growth. Among the parents of children in the schools are many florists who will gladly give helpful suggestions. Often some of the teachers have the necessary knowledge to take charge of the garden. Anyone who can get the spot of land and really wants a garden, and will go persistently about it, will be surprised at the willing coöperation they will receive. Such a garden should not add care to already busy teachers, but should be a relief and a help to them.

THE COLORS OF BUTTERFLIES AND MOTHS

BY VERNON L. KELLOGG

Professor of Entomology, Stanford University

A familiarity with the brilliant color-patterns of butterflies, common to all of us, is not always accompanied, even in the case of teachers pretty thoroughly acquainted with the natural history of our more usual animal kinds, by a knowledge of just how these colors are produced. Yet "what makes the colors?" must be one of the first questions asked by any beginning student of the butterflies. In the following account I attempt to answer this question in a way that may serve as a guide to teachers for the arrangement of some interesting nature-study lessons.

If the wing of a moth or butterfly be rubbed gently between the finger and thumb, a spot on the wing will soon lose its color and become transparent, while on the finger and thumb will be found a fine sparkling powder, the "flour" of the miller-moth, the "jewel-dust" of the butterfly. This dust, rubbed on a glass slide and examined under the microscope, will be seen to be composed of symmetrical tiny scales each composed of a flattened blade and short stem or pedicel. A considerable variety of shape will be noticeable among these scales, and if scales are rubbed from other moths and

butterflies, many new shapes will be found. But through all this diversity of appearance, a fundamental plan of make-up may be recognized in each of these minute structures. Most commonly the scales are more or less ovate in outline with the little stem projecting from the narrower end. The broader end has its margin entire or with dentations of varying depth and number. These dentations may be so deep that the scale looks like a several-fingered little hand. In size the scales vary from .07 mm. ($\frac{1}{350}$ inch) to .8 mm. ($\frac{1}{30}$ inch) if we exclude the long hair-like forms common near the base of each wing, and also the slender elongate ones which project from the wing-margins. In width the scales vary from hair-like to a breadth of .4 mm. ($\frac{1}{60}$ inch). Some scales are as broad as long, or even broader than long. Running longitudinally from base to outer margin are many fine little subparallel lines or striæ. These striæ vary in distance apart, on different scales, from .0007 mm., as in the scales of the great blue Morpho butterflies, to .004 mm., as in the sulphur-yellow butterfly, Catopsila eubule.

The scales cover the wings on both upper and lower sides (in all but a few "clear-winged" moths), being insecurely attached to the wing membrane by having their short pedicels inserted in little pockets or cups on the wing surface. They show an interesting and varying manner of arrangement which varies from an extremely uniform one in butterflies and higher moths to one of much less regularity of disposition in lower moths. On the wings of a butterfly the scales are inserted with their pedicels directed toward the base of the wing in subparallel rows running transversely across the wing, i. e., from anterior to posterior margin, and the scales in each row are at approximately equal distances apart. Their distance is less than the width of each scale, so that adjoining scales overlap laterally and thus make each row to be composed of two tiers of scales, an upper and an under one; the insertion-cups of one tier are very slightly but perceptibly advanced beyond those of the other tier. The scales of the upper tier alternate with those of the lower tier, and each upper scale overlaps laterally two under ones. But in addition to this lateral overlapping, the distance between the rows of insertion-cups is less than the length of the scales, so that there is an overlapping of the tip of the scales of one row over the bases of the scales in the next row in front. By this double overlapping there is formed a complete shingled covering of scales over each surface (upper and under) of each wing. This close placing and overlapping, and the

small size of the scales, bring it about that the number of scales on a single wing is truly prodigious. In a species of Morpho (one of the great blue Brazilian butterflies), for example, the distance apart of the lines of insertion-pits on a bit of the upper wing surface taken from the middle of the fore wing is .151 mm.; the distance apart of the pits in a line is .043 mm. (on the under surface the pits are .05 mm. apart); so that in a space of 25 mm. by 25 mm., about one square inch there would be 165 lines of scales with 600 scales in each line, or 99,000 scales to each square inch of wing-surface. As the upper and under surfaces of the fore and hind wings combined equal about 15 square inches, the total number of scales on the wings of Morpho may be roughly approximated at 1,500,000.

The pedicels of the scales are of slightly varying shapes and of different lengths, corresponding with the pockets into which they fit. Those which enter insertion-cups which are expanded at the base, or at some point between the base and the mouth, present at the tip or between the tip and the point of merging into the blade of the scale, respectively, a slight expansion, so that they are pretty firmly held in the cup by a sort of ball-and-socket attachment. The scales are held in position by the elasticity of the cups which closely clasp the pedicels. After death of the moth or butterfly this elasticity is largely lost, by desiccation of the wing membrane, and the pedicels are more easily brushed from the wing than when the insect is alive.

Now to pay attention to the actual structure or make-up of individual scales. When studied carefully under the microscope singly and in cross-sections of the wing the scales are seen to be tiny flattened sacs, composed of two membranes, enclosing sometimes only air, sometimes pigment granules attached to the inner face of one of the membranes, and sometimes (as observed in cabinet specimens) the dry remains of what may have been during life an internal pulp. The striæ are confined to the outer membrane (that farthest from the wing-membrane) and are probably folds in this outer membrane. These striæ are plainly elevated above the interstrial space. All scales, excepting some scent-scales on male butterflies, possess these longitudinal striæ, which traverse the scale from base to outer margin and are very sharp, and separated from one another by equal distances. The striæ sometimes curve in at the lower angles of the blade, converging toward the origin of the pedicel; in other cases they fade out at these angles. In scales of the common Monarch butterfly Anosia plexippus from 33 to 40 striæ, averaging .002 mm. apart, are present

on each scale. There would thus be 12,500 of these striæ to the inch. On the transparent scales from Morpho the striæ were .0015 mm. to .002 mm. apart; on opaque (pigment bearing) scales from the same specimen the striæ were from .0007 to .00072 mm. apart, or at the rate of about 35,000 to the inch.

If we examine a long series of scales brushed off from different parts of a wing of moth or butterfly, we can always note a series of gradating forms running from slender hair-like form to typical short, broad, flat scale. The significance of this, when we come to inquire about the origin of scales, is plain. Scales are unusual structures among insects; besides the moths and the butterflies, only few beetles, the mosquitoes, and fish-moths, and a few other scattering insects have them. But all insects have hairs. Hairs are structures common throughout the class. And it is certain that scales are derived or developed from hairs. They are a specialized, a highly modified sort of hair. On the lower, the more generalized moths, the hair-like scales are the more abundant. The wings show a thick intermixing of loose, fluffy hair-scales or scale-hairs with more typical scales irregularly arranged. In the higher Lepidoptera, the specialized sort of hairs, namely the scales, compose almost exclusively the wing-covering, and these scales are arranged in the specialized uniform shingling manner previously described. But even on the wings of a butterfly all the gradations from hair to scale can be found by going from base out to discal area of the wing. These gradation series vary in character in different families. In some the hair becomes a scale by shortening and broadening, keeping its free tip entire; in others the hair splits distally and then each branch splits again, and so on, while the base is continually shortening and broadening so that the scale form finally reached is a fingered or deeply-toothed one. But in all the series the final result is that from a long, slender, subcylindrical hair is evolved a short, broad, flattened, little scale. A study of the actual development of an individual scale on the forming wing of a butterfly during the pupal or chrysalid stage confirms the hypothesis of the evolution of the scales. In the growing developing wing the scales begin as hairs, arising by the extension of certain hypodermal cells in the wing-membrane which gradually change in the few or many days of pupal development into typical scales.

We have studied now with some care the general character of the scale covering of moths and butterflies, and the actual structural make-up and the origin of the individual scales. And we have learned

at the very beginning of our study that it is the scale-covering which is the producer or carrier of all the brilliant and varied color and pattern which characterize the moths and butterflies. When we rub off the myriad little scales the wings themselves are found to be colorless, transparent. We have now to note how it is that the scales, the color-carrying organs, actually produce the colors.

The scales in their fully developed dry condition are chiefly cuticular in structure, but they may contain pigment granules and various substances left by the hypodermal cell-layer in drying. The colors of the scales are to be classified then as both cuticular and hypodermal in character, and both chemical and physical in origin. For the most part they are strictly combination colors due to chemical (pigmental) substances within the scale and to the structural character of the scale-walls. The pigment granules within the scales are brown, yellowish, or reddish, and as they mostly transmit the same colors as they reflect, the colors of strongly pigmented scales are the same by transmitted light (light shining through them) as by reflected light. But with the physical colors this is not the case. Scales which produce brilliant blues and other colors are often empty, and these when viewed by transmitted light are nearly colorless. Or they may contain pigment and then when viewed by transmitted light show a dull brownish or yellowish color entirely different from the metallic iridescence which they show by reflected light.

The physical color effects produced by scales are due to their (a) lamination and (b) striation. Each scale is composed of a pair of thin subtransparent laminae (lamellae), the thin dry sides of the flattened sac, and when arranged in the shingling sheath over the wing-membrane, overlapping each other at sides and ends, they produce a layer of superposed thin transparent lamellae which is exactly the structural condition necessary to the production of varied refraction (interference) effects of color. This scale layer produces color by virtue of its structure just as a piece of laminated mica or bit of old weathered glass or film of soap-bubble produces color (Newton's rings). In addition the striæ-bearing outer surface of each scale is essentially the same as a ruled surface or grating, producing color by diffraction and interference just as do the well-known Rowland's and Rutherford's gratings, familiar to students in physical laboratories. In the finest of these artificially striated gratings the lines are about .0006 mm, apart: in butterfly scales the striæ are from .002 to .0007 mm. apart.

The blacks, browns, yellows and dull reds of butterflies and moths, then are produced chiefly by pigment; while all the brilliant metallic colors, the iridescent blues and greens, and hosts of allied shades, are due to the structural or physical make up of the scale-covering. The patterns, varied and intricate, with lines and spots and bars, sharply deliminated or softly merging into the ground color or into one another, depend on the fact that the color units, the scales are so small that by the juxtaposition of scales containing different pigments, or varying slightly in structure, different colors may be produced abruptly or gradually, depending upon the degree of regular arrangement, in the higher moths and butterflies, of the short, rigid, little scales, definite lines and sharp limits to spots and bars are possible. In the lower fluffy moths where the scales are hair-like and irregularly arranged such sharp deliminations of pattern parts are not always possible. Thus the specialization of the scales, both as to structure and arrangement, in the brilliantly colored and complexly colored day-flying Lepidoptera is seen to be exactly connected with the specialization of color and pattern.

We have carefully refrained from referring to the probable uses and significance of the colors and patterns of the butterfly wings. That is a subject which requires a paper to itself. But as a basis for any study of the significance of color pattern among butterflies and moths the first requisite is a knowledge of the actual mechanism of color production, and this is what the present paper attempts to explain.

CANADIAN DEPARTMENT

EDITED BY PROFESSOR W LOCHHEAD

The Macdonald College, St. Anne de Bellevue, Quebec

The work along nature-study lines now being developed in Canada and the support which this magazine has from the beginning received from Canadian subscribers make it desirable that a department should be edited by some one directly in touch with the work and workers. Professor Lochhead, formerly of the Ontario Agricultural College and recently appointed to the new Macdonald College, has consented to undertake the labor of collecting and editing notes and articles dealing with nature-study in Canada. Manuscripts should be sent directly to him at the address given in the heading of this department.

M. A. B., *Managing Editor.*

DISCUSSION AND CORRESPONDENCE

[EDITORIAL NOTE.—The usefulness of this journal would be greatly increased if readers would feel free to write to the Managing Editor for publication their opinions of articles published. Perhaps many readers have forgotten the following Editorial Note which appeared in No. 1 of Vol. I: All articles in THE REVIEW are open to discussion and readers are invited to send their contributions to this department as soon as possible after the publication of the paper to which reference is made. The Editors must reserve the right to select and abridge if space is limited, and to modify criticisms which tend to be so personal or acrimonious as not to be helpful. The weak points of the nature-study movement deserve free discussion, but in the spirit and form of good friendship for all persons who may represent opposing views.]

Best Books for Nature-Study.—The editor was right when he said, in his introduction to the lists of "Best Books for Nature-Study," that "there are many surprises (here) for the reader." The statement is true but it fails to deal adequately with the situation. The lists are absolutely astounding. That so many accomplished workers should so totally ignore the classics among nature-study books is almost incredible. But the amazing fact remains that these learned persons have put in their lists such trifling things as hand-books and guides, however excellent these may be in certain specific aspects of the study.

If a literary periodical should call for a list of ten masterpieces from the world's literature, who would suppose that Emerson, Milton, Shakespeare would be omitted and their place supplied by text-books on rhetoric, elementary treatises on grammar, or "lists of English words commonly misspelled?" This in effect is what these lists have done.

I supposed that "best books" meant the best in theory, in spirit and in their suggestions for the use of materials; but it appears that I was wrong.

Suppose that the editor should call for a description of "the best sources of drinking water for our large cities." I am prepared, by the book lists just published, to feel no surprise if you mention sprinkling carts, rain-water hogsheads, fibre pails, soda-water fountains, bar-rooms, tin dippers and pocket drinking cups—to the entire omission of clouds, brooks, reservoirs, lakes and ponds.

I note that my own list is the only one that includes Gilbert White, Jefferies and Thoreau. One unsigned list includes Burroughs—with his minor hand-book on squirrels! And but three mention Gibson!

I have no fault to find with the convenient little hand-books that the lists

recommend but to call them the masterpieces of the world's literature in nature-study, to put them among the "best ten," is deplorable. It is worse. It is an outrage on the reader's intelligence. It is all right to collect straws, if the straws are good and are needed, but to call straws the best things in life is misleading, and a misdirecting and wasting of well-intentioned efforts.

In the spirit of such modernism, I rise to inquire in the famous phrase of the perplexed and embarrassed congressman, "Where are we at?"

I recall that years ago, in one of my rambles, I saw a barn and on one side of the building a target at which "the boys" had been shooting. As I desired to see how near they had come to the center, I made an examination. I found that the region in the immediate vicinity of the target was well peppered, and at one or two points, pretty well shattered; but the target itself had not suffered any great injury. And as I examined the stray and scattering shots, I was impressed by two unexplainable facts. First, why some were so near to the eaves, and second, why with so many shooters so much of the barn had escaped.

I have a similar sensation when I examine those lists of nature-study books. What a peppering and scattering of shots was given to Bailey, Hodge, Comstock, Chapman and Blanchan. School-gardens, a recent suggestion in nature-study, came in for fair "marks." But how near the eaves were some of the shots and how far afield. Why you could find an occasional bullet sticking in the trees of the next farm, good bullets, too, and effective hits, if only the trees had been the target. Such marksmanship makes one excited. If the game is to be played all over the barn and the surrounding landscape let's "pepper" things some more.

In view of the prominence and efficiency of aquaria in nature-study, why has no one said a word about Bateman's "The Book of Aquaria?" Tadpoles must be going out of date!

Then isn't it astonishing that the omnipresent characters of nature—the sky and the weather—were totally ignored? And not the slightest reference to the use of the microscope, camera, opera-glass or telescope. When bullets were flying wild I wonder why some of these things didn't get hit by accident. Surely the books in the appended list are better entitled to mention than some that were lauded:

"The Sea-beach at Ebb-tide"—Arnold. "Sea-shore Life"—Mayer. "The Common Spiders of the United States"—Emerton. "Tenants of an Old Farm"—McCook. "The Teaching Botanist"—Ganong.

Though many technical scientific works are mentioned, everybody seems to have overlooked a little man by the name of Darwin who wrote a little book called "The Origin of Species."

But Darwin needn't feel badly, for nobody had heard of Leidy, either. One would hardly expect these two to be mentioned in a list of nature-study (not science) books if Huxley, Spencer, Gray and Le Conte had not been included.

Burroughs needn't feel chagrined, for one writer knew him by his "Squirrels and Other Fur-Bearers"—a collection of excerpts. I do not believe that "the dean of American naturalists" even suspected that his "Squirrels" is his high-tide mark. But it seems that it is. Seton Thompson comes into the list, but no one had a kind word to say for Long. But Long needn't feel hurt for he was left out in good company, and so fared Torrey, Van Dyke, Mabie, Hulbert, Williams, Lubbock, Taylor. But Maeterlinck got hit once—by a stray bullet, probably.

Though nature-study is supposed to have some sentiment mingled with its cold facts, no mention was made of Wordsworth, Whittier, Bryant or Keats. In fact the poets were not "in it." But who cares? We got "Sanitary Health," "Bacteria," and some science readers. I have great respect for the nature-study worker who would include "Mary's Little Garden" among the best ten nature-study books. I am sure that botanically that book is all right. But as I am somewhat of a zoölogist, I want to put in a plea for that classic commonly known as "Mary's Little Lamb."

STAMFORD, CONN. EDWARD F. BIGELOW.

I was much interested in the suggestions regarding the best nature-study books, in the last issue of the REVIEW. I understand that you had in mind such a list as would be helpful to the average grade teacher. I must confess that the teachers with whom I have had experience could not use at all the great majority of books suggested. From three years' experience as supervisor of nature-study, I would suggest the following list for the use of the average teacher who has nature-study in her list of subjects to be taught:

Hodge's "Nature-Study and Life;" "Cornell Nature-study Leaflets;" Bailey's "Nature-Study Idea;" Blanchan's "Bird Neighbors;" Blanchan's "How To Attract The Birds;" Comstock's "Insect Life;" Miller's "Brook Book;" Keeler's "Native Trees;" Dana's "How to Know the Wild Flowers;" Dana's "How to Know the Ferns."

I think a single list of about fifteen selected from those handed in would be helpful to teachers.

PASSAIC, N. J. GILBERT H. TRAFTON.

I am surprised that none of the people who answered your inquiry as to the best ten nature-study books should have recommended Hornaday's "Natural History." To my mind this indicates a woeful lack of investigation on the part of the experts who answered your call. As you doubtless know, Mr. Hornaday's book was prepared especially for use in schools, and it is the only complete history of American wild mammals, birds, reptiles and fishes ever written. It should by all means be in the hands of every nature teacher in this country, and it would be if they all knew its value.

OFFICE OF *Shield's Magazine*, NEW YORK. G. O. SHIELDS.

The lists of books suggested for teachers of nature-study in the May issue certainly had surprises, and left on my own mind the idea that nature-study as an informational subject is certainly lacking in even the most generalized "standards." The frequent mention of books devoted exclusively to the classification and naming of animals, plants, etc., would suggest the "naming of things" is still a large part of the nature-study work. This is to me at least, the least significant part of a nature-study lesson. We certainly must supply a name for whatever object the child studies, but it should be done in the most matter of course way.

A nature-study lesson, like any other given in the common schools, should supply useful and usable information for the child's guidance. When this is neglected the claims for a place for nature-studies in the grades lose practical force. As a school subject it is not sufficient to say that nature-study should be a study of nature. The subject matter should be largely selected with broadly utilitarian ideas in mind,—at least if it is to abide in the affections of the pupils and the laymen.

Now this problem of "best books" for teachers of nature-study is a very practical and pressing one. Few of our teachers have the ability and the preparation to organize a series of lessons covering such a wide range of information and materials—to say nothing of the lack of time for such work. The most helpful book is one that supplies the suggestions as to materials and ideas marked out in full, together with suggestions as to method and order of presentation. Now, unfortunately such books are not available and the teacher must have time, or take time to "work up" each topic presented. In this even the most vigorous advocate of objective study of nature must rely to a large degree on "books."

Recently a teacher who had taken some of the freshmen courses in botany and zoölogy in the university applied to me for suggestions for books that

would be helpful in nature-study work. Such requests are frequently made. Here is the list given in this particular case. It will be noticed that books dealing with physical and animal nature-studies are not included. For these she was referred to teachers with broader outlook in their fields.

(1) Complete file of THE NATURE-STUDY REVIEW. (2) Bailey—"Nature-Study Idea." (3) McMurry—"Special Method in Elementary Science." [I was surprised to see this excellent book unmentioned in the May issue.] (4) Goff—"Principles of Plant Culture." (5) Bailey—"Lessons with Plants." (6) Atkinson—"First studies in Plant Life." (7) King—"The Soil." (8) Darwin—"Animals and Plants under Domestication." (9) Beal—"Seed Dispersal." (10) Gaye—"The Great World's Farm."

DEPARTMENT OF BOTANY, UNIVERSITY OF TEXAS. A. M. FERGUSON.

THE ORGANIZATION OF A NATURAL HISTORY CLUB[1]

The object of organizing a natural history club is to foster a love of nature and a desire to learn more about natural objects than is possible in the class routine. The mere fact of being forced to learn the facts of the daily lesson often prejudices the pupil against any great enthusiasm about them. Formal science, notwithstanding its acknowledged value, often falls short in bringing nature to the student in an attractive way, and if the regular work be supplemented by such a club as this the result may well be a permanent interest in out-of-door things.

The society must be so planned and organized that the results indicated in the preceding paragraph will accrue to the members. The initial enthusiasm must be wisely guided if a successful club is to be maintained.

Kinds of work to be done

The work proposed for such a clnb is divided as follows: (1) Original observations by members. (2) Reports of what other investigators are doing.

It may be best not to do any work of the first sort at the outset. If one member happens to know considerably more than the others about any par-

[1]Abstract of a paper by H. M. Benedict, in University of Cincinnati Teacher's Bulletin, April, 1906.

ticular department of natural history he should be given ample opportunity to make reports at meetings. It is suggested that the son of a druggist might be interested in giving accounts of medicinal herbs ; the son of a doctor in doing likewise with bacterial diseases. A boy who is merely an out-and-out nature lover may be encouraged to tell of the haunts and ways of wild animals, etc. Any member especially interested in a certain line of work should be made the club's representative to look after and be responsible for that department. The success of the club depends largely on making use of all the native interest found in the members.

One of the most valuable features of the work is excursions by the club for the study of living things in their natural environment. Each trip should be for some special object, and if possible in charge of some member who is to represent the topic. Pond life, stream life, life under stones, in and on rotten logs, bird trips, tree trips, and wild flower trips are some of the fields of useful investigation.

The aim of these trips should be not collection but recognition. Attention should be centered on remembering something definite rather than on seeing how many different kinds of things may be gotten. However, every school should have a museum and the surplus energy of the members may well be used in having them look for and collect such materials as may subserve some useful end in the museum. To this end the club should have a curator who shall be responsible for this department and at the meetings report on donors and donations as well as desirable additions to the collections.

The second class of work will occupy most of the time, and will be the principal part of the work. A list of available magazines should be made, and they should then be apportioned among the various members. The members are to give talks on the interesting biological items or accounts which have appeared since the last meeting. This plan makes it possible for the society to keep in touch with biological activities in the world with comparatively little work on the part of individuals.

One rule, the transgression of which means sure death to the club, is laid down—*Never, under any circumstances, permit a written report to be read.* This is the one thing that is paramount in such an organization. Everything savoring of the literary or musical society must be rigidly excluded. The reports must be brief and pithy.

The teacher should act *only in the capacity of adviser* and under no circumstances should he accept office. If the club leans on the teacher for support it will defeat its own ends.

Details of organization

The following rules have been found useful in carrying on such work: (1) The students must be left absolutely free to choose their own president, secretary and treasurer. (2) Assignments of magazines should be made by the president. (3) Either the president or an elected committee must prepare programs for the meetings. (4) Meetings should be bi-weekly. (5) Avoid roll-call and anything else which suggests class-room discipline. (6) Have as many field trips as possible. (7) The organization should be permanent, continuing year after year, with the same name and insignia. (8) After the first year, have the old members select new ones on the basis of demonstrated ability in natural science. (9) No visitors or outsiders should be permitted to attend meetings. (10) Members doing extra good work in the club may well be excused from final examinations in biology in the school.

TEACHERS COLLEGE, COLUMBIA UNIVERSITY. C. A. MATHEWSON.

BOOK REVIEWS

Ways of Nature. By John Burroughs. Boston: Houghton, Mifflin. 1905. Pp. 280. $1.10.

No reviewer could express the point of view of this book so well as the author has in the following extract from the preface: "My reader will find this volume quite a departure in certain ways from the tone and spirit of my previous books, especially in regard to the subject of animal intelligence. Heretofore I have made the most of every gleam of intelligence of bird or four-footed beast that came under my observation, often I fancy, making too much of it, and giving the wild creatures credit for more 'sense' than they really possessed. The nature lover is always tempted to do this very thing; his tendency is to humanize the wild life about him, and to read his own traits and moods into whatever he looks upon. I have never consciously done this myself, at least to the extent of wilfully misleading my reader. But some of our later nature writers have been guilty of this fault and have so grossly exaggerated and misrepresented the every-day wild life of our fields and woods that their example has caused a strong reaction to take place in my own mind, and has led me to set about examining the whole subject of animal life and instinct in a way I have never done before."

The conclusion of Burroughs' studies are interesting, coming as they do from a man who has led a literary career as opposed to that of a psychologist of the Lloyd Morgan school: "I confess I have not been fully able to persuade myself that the lower animals ever show anything more than a faint gleam of what we call thought and reflection—the power to evolve ideas from sense impressions,—except feebly in the case of the dog and the apes, and possibly the elephant. Nearly all the animal behavior that the credulous public looks upon as the outcome of reason is simply the result of the adaptiveness and plasticity of instinct. The animal has impulses and impressions where we have ideas and concepts. Of our faculties I concede to them perception, sense memory and association of memories, and little else." Such is the conclusion to be drawn from the observations recorded in this book, and the notes on observations are so interesting and productive of independent thinking that every serious teacher of animal nature-study will do well to read this book. There are many minor points where one who has observed for himself will not agree, but such disagreement ought to stimulate further investigations.

Dynamic Factors in Education. By M. V. O' Shea. New York: Macmillan. 1906. Pp. 320. $1.50.

This book has been prepared to advance the author's view that the motor and physical factors in teaching are of fundamental importance and deserve more attention than has been given them. Part I of the book deals with the motor factors in education, pointing out that motor activity is the chief characteristic of young children and concluding that "nothing should be taught that cannot be *lived*, *worked out into conduct*, *established in motor experience;* this is the first educational law." It is evident that manual activities must be prominent, and the author has abundant suggestions applicable to the various subjects taught in schools. Part II deals with the energic factor in education. Energy must be used economically. Needless motor tensions squander energy. Tasks requiring fine adjustments should be replaced by coarser activities. Equipment and hygienic management of the schoolroom should reduce waste of nervous energy to the minimum. The most valuable energy-conserving equipment is a well-poised, *strong* teacher.

Nature-study is not mentioned directly, but it is evident to the reader that nature-study and elementary science on an active basis (and no other method is now approved) is fully in harmony with Professor O' Shea's first educational law.

The book is dedicated to Mr. Leaton Irwin, a business man in Quincy, Ill., who has devoted much time and money to the improvement of public schools of his native city.

Mosses with Hand-lens and Microscope. Part III. By A. J. Grout. Published by author, 360 Lenox Road, Brooklyn, N. Y. Paper. $1.25.

This is part of an edition more advanced and complete than the book of same title reviewed in this magazine for May, 1905. There will be five parts, quarto, finest coated paper and illustrations. It is highly commended by botanists who have carefully examined the book.

Baby Bird-Finder. Vol. II. Water and game birds and hawks and owls. By Harriet E. Richards. Size 2⅜ by 4¼ inches. Leather cover 50 cents; paper 30 cents. For sale by author, Brookline, Mass.

A pocket guide to identification. Uniform with Vol. I., Song Birds. Mr. Herbert K. Job urges in the introduction that the birds named are too much neglected by the average bird-lover; but admits that their pursuit is somewhat more strenuous than that of the common song birds.

NATURE-STUDY AND SCIENCE NOTES

[EDITORIAL NOTE.—Under the heading "Nature Notes" this magazine has for some time published brief summaries of important new observations in the study of various phases of nature. The suggestion has come to the Managing Editor from several sources that this department should be extended to six or eight pages, instead of two or three. Will readers kindly write their opinion concerning the usefulness of such notes, especially considering that probably 75 per cent. of the copies go to teachers who are already familiar with the outlines of science and hence ought to have an interest in the new discoveries?]

Protection of Chinchilla. A bill passed recently by the Chilean Congress prohibits killing this valuable fur-producing animal except in certain seasons. The animal, which is rat-like except its fur, lives in the wilds of the Andes, where it burrows in the ground. Although once common, the species is now threatened with extinction by hunters. Twelve thousand dozen skins were shipped last year from Coquimbo, Chile, the leading port of export. [*Journal of Geography*, May, 1906.]

Pearls from Lower California. It is not generally known that from the Gulf of California come large numbers (over two million dollars worth last year) of pearls. An explorer in 1522 found native chiefs with quantities of valuable pearls. Thirty or forty little pearls and possibly one the size of a pea may be found in two tons of the pearl-oysters, each oyster weighing about a pound. A number of pearls have sold for more than $5000 each,

three or four for more than $10,000, and one for $50,000. The shells of the oysters are used for making buttons. [*Journal of Geography*, May, 1906.]

Old Horses. A new law in Massachusetts makes it unlawful to offer at public sale or to lead, drive, or ride on any public way (except on the way to the proper place for humane keeping or killing) any horse which could not be worked without violating the law against cruelty to animals. Heavy penalities are provided for violation of the law.

Oology. In *Bird-Lore* for May, Professor Montgomery, of Texas, deprecates the ordinary collecting of birds' eggs, and points out that little valuable knowledge comes from the collection of shells. Certainly there are many reasons why pupils in schools should be discouraged from collecting eggs.

Alcohol from Sawdust. M. Classen, of the High School of Technology of Aix-la-Chapelle, has just succeeded in making absolute alcohol from sawdust. By treating one ton of sawdust with gaseous sulphuric acid 110 liters of absolute alcohol were made. [*Review of Reviews*, 33: 634, May, 1906]

Aged Tortoise. The famous tortoise which recently died at the London Zoölogical Gardens was supposed to be nearly four hundred years old. It was captured in the Galapagos Islands late in the eighteenth century. A much-worn date carved on the shell led to the belief that it had been captured and marked in the seventeenth century. Of course this is very uncertain evidence; but adding the fifty years necessary for full growth to the time passed in captivity makes it safe to estimate the age above two hundred years. The *Literary Digest* for July 28 gives a photograph copied from *La Nature* of Paris.

An "Intellectual" Horse. The problem of the famous Berlin horse which has long puzzled scientific men by his apparent ability to make simple arithmetical computations and announce the result by a series of pawings, his way of counting, has been solved. It has been discovered that the horse cannot do such tricks when blindfolded, which suggests that it is not a mental process of the horse which leads to the correct answers to problems. By means of delicate apparatus recording movements it has been demonstrated that very slight movements, even unintentional, of the one who gives the problems are noticed by the horse and taken as signals to stop pawing. Although we cannot longer credit the horse with mathematical powers involving intellectual operations known only in the human species, it is evident that he has been trained to be a wonderfully fine observer—almost an equine thought-reader. A long translation of the original German article publishing the latest experiments is given in the *Literary Digest* for July 28.

Artificial Coloring of Flowers. Professor Kraemer, of Philadelphia, has been experimenting with aniline dyes and finds that many of them in solutions (1 part dry dye to 1000 parts water) will color white flowers if the cut flower stalks are allowed to stand in the solution one or two hours and then transferred to water. Some species of flowers take up the dyes readily. A remarkable fact is that only a few of the thousands of kinds of aniline dyes give good results in such artificial coloring. The best dyes are the following, which could be ordered from dealers in chemicals: yellow, the commercial "acid yellow A. T.;" orange, "orange G. G.;" blue, "cyanol F. F.;" green, equal parts of the dyes for yellow and blue; purplish-red, "acid magenta;" crimson, equal parts of "acid yellow A. T." and "acid magenta;" purple, equal parts of "cyanol F. F." and "acid magenta;" gray, "naphthol black B." Carnations will take up colors from the soil without injury to odors or plant. These experiments open up an important line for floral decorators who frequently find difficulty in producing the desired color groups with natural flowers. [*Bulletin Torrey Botanical Club*, 33: 77–92. 1906.]

Diseases of Rodents. The Bureau of Biological Survey, United States Department of Agriculture, has issued a circular letter as follows: It is well known that many species of rodents which live in colonies, such as prairie dogs, rabbits, spermophiles, field mice, and rats, are subject at irregular intervals to microbic diseases in the nature of epidemics, which greatly reduce their numbers. The Department of Agriculture desires to be informed of the presence of such epidemics with a view to isolating and preserving the microbes for use in destroying mammals injurious to agriculture. You will greatly oblige, therefore, by informing the Department of the presence, in your neighborhood, of epidemic diseases among wild mammals, now or at any future time. Such diseases are usually indicated by the presence of numerous sick or dead animals.

Fire Fighting on the National Forest Reserves. The worst enemy of the forests is fire. To combat it the Forest Service maintains a fire fight-system. How effective is this system is shown by the following figures for the last two years: The area of forest reserves in the United States, exclusive of Alaska and Porto Rico, was on January 1, 1905, over 58 million acres and nearly 390,000 acres had been burned over. One year later the reserve area had been almost doubled, the burned area had been reduced by more than one-half, and the percentage of area burned had been reduced by more than three-fourths.

Only since February 1, 1905, have the reserves been under the adminis-

tration of the Forest Service. The working out of a system of effective control of fire on the reserves is still in its infancy. But it is believed that under expert care the injury to the National forests can be rapidly and permanently cut down. The direct loss from forest fires in the United States runs annually into many millions of dollars, while the indirect loss is beyond estimate.

A constant lookout for fires is kept from ridge trails and commanding points during the danger season, and the reserves are patrolled as efficiently as possible with the force available. Roads, trails, and fire lines are constructed, affording means of rapid communication and points of vantage at which to arrest the progress of a fire, and telephone lines are being run to help give warning and summon assistance.

Every forest supervisor is authorized, in person or through a subordinate, to hire temporary men, purchase material and supplies, and pay for their transportation from place to place to extinguish a fire. When the cost is likely to exceed $300 the supervisor telegraphs the Forester for authority to incur the additional expense.

During the calendar year of 1905, 36 of the 93 reserves escaped fires, altogether. On the remaining 57, areas were burned over ranging from 1 to 79,083 acres (Northern Division of the Sierra Reserve) and amounting to 279,592 acres. The largest amount of timber was destroyed on the Lewis and Clark Reserve (Southern Division)—42,893,000 board feet. The total for all reserves was 152,557,000 board feet, with a value of $101,282, but the greatest loss in money value was $27,320 on the Priest River Reserve. The total cost of extra labor and supplies for fire fighting was $12,573.52.

The seasons of greatest danger from fire are spring and fall. General co-operation of all coming in contact with the forests is earnestly to be sought, first, to guard sedulously against the starting of fires, and, second, to aid in every way in extinguishing such as occur. [From *Press Bulletin* of Forest Service.]

Rabbit Poisoning and Bees. Great havoc has been wrought among bees by rabbit poisoning in Australia. Not only are bees being destroyed, but the native birds are being completely killed out in some districts, with the inevitable result that blowflies and other noxious insects have become serious pests, and it is hard to say where the matter will end. [*Agricultural Gazette, N. S. W.*]

NEWS NOTES

Nature-Study in the Public Schools of Tennessee. Beginning with September, elementary nature-study will be introduced into the public schools of Tennessee throughout the entire state, under the direction of Supt. S. A. Mynders. Bulletins of information and instruction will be furnished to the teachers sufficient to supply all pupils free of charge. The work will begin with a study of the nature and cultivation of our common plants and will be extended and developed from year to year. The September number of the *Progressive Teacher* (Nashville) will give a full outline of the work as planned by Supt. Mynders, together with instructions for teachers.

Agricultural Instruction in Virginia. The subject will be introduced into many schools this year. The educators in charge of the work have wisely decided to make the introduction gradual as teachers are able to do the work well.

Notes from Schools. The managing editor again reminds teachers that notes concerning the actual work of nature-study in the schoolroom are always wanted for publication. If any point especially interests you send a note to the REVIEW.

Questions and Answers. This department is not discontinued permanently but will appear again when readers contribute questions of general interest. Send your questions to the managing editor. If they are not likely to interest many readers the answers will be sent you by letter as soon as the desired information can be obtained.

RECENT (1905--1906) BOOKS IN NATURE-STUDY AND SCIENCE

First Course in Physics. By R. A. Millikan and H. G. Gale. A one-year course for third year pupils in high school. Emphasizes the every-day practical aspects. Boston: **Ginn & Co.** 1906. $1.25.

First Science Book. By L. D. Higgins. An abbreviated course in elementary physics for grammar or early high-school years. Boston: **Ginn & Co.** 1906. 65 cents.

Elementary Physical Science for Grammar Schools. By John F. Woodhull. A text-book based on the syllabus for seventh and eighth grades in New York City schools. New York: **American Book Co.** 1905. 60 cents.

Entomology. By J. W. Folsom. A concise and comprehensive account of insects with special reference to their biological and economic aspects. Pp. 485, 300 figs., 5 plates. Philadelphia: **Blakiston's Son & Co.** 1905. $3.00.

Experimental Physiology and Anatomy for High Schools. By W. H. Eddy. A practical guide for laboratory study. New York: **American Book Co.** 1906. 60 cents.

Wilderness Babies. By Julia A. Schwartz. A school reader dealing with life of young wild mammals. Boston: **Little, Brown & Co.** 1906. 60 cents.

Ways of Nature. By John Burroughs. A study of the "intelligence" of animals, and criticism of the tendency to humanize them. Boston: **Houghton, Mifflin & Co.** 1905. $1.10.

Text-Book in General Zoology. By H. R. Linville and H. A. Kelly. A text-book, with laboratory suggestions, for high schools and general readers. 460 Pp., 233 ill. Boston: **Ginn & Co.** 1906. $1.50.

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THE NATURE-STUDY REVIEW

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CONTENTS

PAGE

School Gardens in the Refugee Camps of San Francisco. BERTHA CHAPMAN..... 225
The Field Trip in Nature-Study. S. COULTER..... 230
Methods of Teaching Nature-Study. A. J. GROUT..... 233
The Weakness in Teaching Nature-Study W. T. HORNADAY..... 241
Nature-Study. S. A. JOHNSON..... 244
CANADIAN DEPARTMENT. Edited by W. LOCHHEAD
A School of Affairs..... 249
Canadian News..... 252
Crickets for Study in the Schoolroom. F. A. STEBBINS..... 253
Rearing of Roses from Cuttings. E. YODER..... 255

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THE
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VOL. 2 OCTOBER, 1906 NO. 7

SCHOOL-GARDENS IN THE REFUGEE CAMPS OF SAN FRANCISCO

BY BERTHA CHAPMAN

Supervisor of Nature-Study, Oakland, Cal.

[EDITORIAL NOTE.—There are many cases of school-gardens having been very successful under conditions which seemed unpromising, but certainly there have been none which in unfavorable conditions might be compared with those which in the past summer have existed in the refugee camps of the Pacific Coast city where those made homeless by the great earthquake disaster are temporarily being sheltered. The newspapers have from time to time mentioned the schools for the children in these camps, but no one would have expected that Principal Armstrong would find it possible to develop school-gardening. In many schools in other places officials are waiting for a very propitious time in which to make a start with gardening. Mr. Armstrong has set a good example by beginning under the most unfavorable conditions which could be imagined.

This work in the refugee camps is laying the foundation for a movement towards a permanent garden system in the new San Francisco which the architects are planning. Notes concerning later developments will be published in THE REVIEW.]

Out beyond the long line of tents in Golden Gate Park, where thousands of the refugees from the San Francisco fire are temporarily finding shelter, I found the cluster of tents where hundreds of the children of the poor are enjoying going to school. I say enjoying advisedly, for as I walked along the path-way I saw many small groups of children sitting under the trees studying diligently and from the wide spreading tents came the murmur of small voices. Youngsters with big round eyes sat listening to one teacher tell the ever-interesting tale of the Three Bears. The great big bowl for the great big father bear, and the smaller bowl for the mother bear, and the tiny wee bowl for the baby bear, must not be interrupted so I passed on by the tent where the children were struggling with the number of marbles that

John would have left, on to the tent beyond and where I found just what I was looking for. Here the wee tots were busily folding papers to hold the precious seeds the Principal was distributing to the class.

These were the babies who had raised their tiny voices begging for gardens of their own after they had seen the upper class children working on their "farms." The greatest excitement reigned, for each tiny patch of ground had been carefully prepared the day before and the great "planting time" was here. Each child was to choose four different kinds of seed for his own garden and how seriously this choice was taken—should it be carrots or turnips! Of course everybody wanted radishes, for they are "finished so quick"—as one boy told

Photograph loaned by *The Call* of San Francisco.

The procession on the way to the gardens. Principal Armstrong distributing seeds.

me—and are "round and red and good to eat." When the papers were folded each child passed in turn to receive his pinch of chosen seed from the cheery Principal who had a kindly word and a gentle smile for each.

When all were provided with seeds, these tots marched in glee to plant their four rows. Round faced and almond-eyed baby Sing worked beside a tall dusky Portuguese boy, while two little people fell naturally in their moment of deep interest to chattering in their native Yiddish, and there beyond glowed the merry face of Pat with the red

hair and freckles. Some of the children showed signs of having careful mothers, but many more, poor children of the street, let one read the sorry story of their birth in their sad pinched faces and dull eyes.

"This is all right, but you just ought to see what the big fellows are doing up on the farm." This bit of information was volunteered by a boy from whose lips words fell with the truest "South of Market" click "Sure I will show you the way." He knew everything in the Park for he was "in with all the men." It was not a bit like going to school out here, for they studied under the trees and could run out at recess and ride the donkeys. "It seemed like a great time camping out, this living in tents." So he chatted on till the Park seemed on the point of forgetting that it had ever been reclaimed from the desolate sand-dunes of the ocean beach. There in almost the last place one would think of looking for gardens the Park Commissioners have set aside a piece of ground for the experiment Principal Armstrong has undertaken with these refugee children.

It looks discouraging enough at first glance when you see what difficulties the man has had to overcome. The land was plowed, leaving here great hard unbroken clods and there almost pure sand; here a hollow, there an abrupt elevation, and yet worse than all this there was no water.

To those who do not know children these things would stand for discouragement and defeat, but fortunately Principal Armstrong knows children and recognizes the best that is in them. Armed with tools that the Board of Education has generously provided for him, the small army marched out single file to conquer this piece of unruly land. And what a picture they did make! Each child was given a patch of land about 10 feet square which he marked off with stakes and string and with a will they all set to work. In a short time order seemed to be coming out of chaos. To be sure paths were not all straight, for of course John was ambitious to get every inch of land belonging to him and even crowded the path a little, or Henry was not quite equal to the heavy ground that had fallen to him and wearied before the path was reached; but what does the straightness of a path mean amid all this earnest delightful work? Everybody wanted to get his bed in order first and then to help out his neighbor in any possible way. Joe had hurt his hand and could not spade, and as he stood rather helplessly by his garden three of his friends cheerily volunteered to help him out and at once set to work. In time seeds were planted in

long rows as straight as could be expected. At the beginning of the row seeds fell thickly only to dwindle to a sorry stream at the end and some were planted too deep. Yet the eagerness with which they were cared for and the intense joy that greeted the first flush of green more than made up to the child's spirit for all the shortcomings that might present themselves to the man who looks for perfection in the works of children.

Weeding time had come for some and I heard many excitedly discussing as to whether the plant in question really was a weed or one of the

"A grotesque scare-crow keeping guard over a trim little patch."

precious plants. How should they tell? "Pull it up and look at the seed," one chap suggested very much to the point, or as another put it, "Let it alone till the leaves get bigger and then you can tell all right." Mr. Armstrong himself has had water-pipes laid from the main camps and here boys were at work with long hose, watering their gardens and learning to sprinkle carefully that the small plants might not be washed out of the ground. One boy would not pay proper attention to his work, so promptly another boy came forward and took the hose away from him, for an incompetent man must not be allowed to spoil the farm. Beyond the reach of the stream young farmers

were busy carrying water in small tin cans. The sandy soil drank deep of the precious water and the efforts of the eager children to give their young plants all the help they could seemed almost pathetic. Everyone was at work. No one needed to stand over these children to keep them at their tasks. They needed help, encouragement and direction; and Mr. Armstrong was everywhere with a word of praise for a good straight row of beets or turnips, a particularly fine potato plant or a well made frame for the vigorous bean to climb upon. He it was who took the hoe to show the best way to use it; and it was his cheery word, as he laughed at the grotesque scare-crow keeping guard over a trim little patch, that made the children glad to be preparing a great feast for the many tiny visitors that kept up a merry chatter in the trees overhead as if already on the watch for the first green lettuce leaves.

No serious agricultural problems are here being struggled with, no profound experiments tried; only the attempt to show these children of the city streets how many good things to eat and how many attractive flowers can be raised on a tiny patch of ground they can care for themselves and with all how much fun there really is in digging and planting in the soil. All this goes back to the homes. Parents at first looked askance at this work but later as their children began to get the land in shape and took real interest in doing these commonplace things they were amused and gradually they came out to help. They broke up the particularly rebellious clods for some wee thing or watched to see that some careless dweller in the tent city did not walk upon the gardens. Here and there small isolated garden patches made their appearance, some bearing signs that told us that the grown-up children were not willing to be deprived of the joy of seeing the ever marvelous awakening of the seed germ. Here and there through the camp tiny patches of garden appeared beside the tents made by children and parents, showing how far reaching was the interest taken by old and young alike.

Good pure air and vigorous exercise under influences that make for cleanliness is doing much to help these people to learn how to live. After seeing these happy children learning out in the open air by doing things for themselves with their own hands and heads, we must wonder if perhaps for many of them the earthquake and fire may not in after years prove a blessing rather than a calamity.

THE FIELD TRIP IN NATURE-STUDY

BY STANLEY COULTER

Professor of Biology, Purdue University

In order that nature-study may work its perfect work the child must be brought face to face with nature. In other words, field trips are absolutely essential in successful nature-study work. The field trip has perhaps presented the most serious difficulties involved in the subject; difficulties, however, of fairly easy solution save in exceptional cases such as those furnished by schools located in the congested districts of great cities. Teachers in some cases regard the field-trip as a failure, in others as a positive damage, in very many others as an annoyance to be suffered as rarely as possible.

In the main these difficulties arise from two sources: first an imperfect conception of the purpose and limitations of natnre-study, and second failure in the organization of the trip. The character and extent of the trip is of course largely determined by the mental and physical capacity of the child, but whatever its character certain fundamental principles are involved in every successful field trip. These may be summarized as follows: (1) A definite purpose. (2) A reasonable purpose, or one that is wholly within the comprehension of the child. (3) A reasonable distance to the area to be studied. (4) A definite and limited area of fairly distinct boundaries.

Nothing works greater disaster in a field trip than the absence of a definite purpose. The surest way to bring about failure is to trust to what the children see without direction and without purpose. In such cases there can be no means of control, no method of comparing results; there is none of the fine stimulus of competition and of reinvestigation because of differing results, no eagerness for accuracy. I once visited a summer laboratory in which the direction given to the student was, "go out and catch what you can and then study what you catch." The result was poor with university students; it certainly gives no more promise of good results for pupils in the grades. Many of the children have absolutely no point of contact with nature, others will be interested for a brief time only in the more evident features of local interest, and but a very few will gain any real or permanent good. But with a definite purpose these difficul-

ties vanish and the field trip becomes a stimulus of the highest value.

The purpose of the trip must be easily within the comprehension of the child. Many field trips lose all of their helpfulness because the purpose assigned is beyond the mental grasp of the children. In the earlier years the purpose should be very simple, as a rule, single. A field trip in which children of the first, second or even third year are expected to see the adaptations of foliage leaves to secure the light relation or protective devices in plants or animals is an absurdity. The idea of a struggle for existence has not entered the mind of the average child of these grades and even the most perfect and evident adaptations make no appeal to his interest or understanding. Nothing is more disheartening to a child than to be assigned a problem beyond his powers, and nothing on the part of the teacher is more inexcusable than to assign such a problem. In the more advanced grades the purpose may of course be more complex, in some cases indeed, different purposes may be assigned to different groups of pupils. It is safe to say, however, that, as a rule, the error in the field trip has been that its purpose was beyond the grasp of the child. This attempt to compel pupils to do work beyond their powers is all too common. The attempt to transfer college work to the high school and high-school work to the grades may perhaps arise from a laudable ambition, but it is an ambition not tempered by judgment and is one of the most dangerous phases of the educational methods of today. The attempt to treat nature-study as elementary science falls in this category and explains its failure in many cases.

The materials of nature-study are those next at hand and in a large majority of cases no extended trip is required in order to reach a suitable area for the special purpose in view. Apart from the loss of time involved in a long trip, the weariness of the children preventing them from entering upon the real work of the trip with enthusiasm and vigor, and the added responsibility to the teacher, there is a greater loss in losing sight of the fact that the near at hand, even the common things, are worthy of study and full of interest. One of the most valuable features of the true nature-study is that it dignifies the common place and clothes with interest the child's immediate surroundings. It is in this respect more than in any other that the teacher in the densely populated districts of great cities works at disadvantage. The manner in which this disadvantage may be overcome, in part at least, I hope to discuss in a later article.

As disheartening as a purpose too complex is an area too great.

In the first case the work cannot be understood if done; in the second it cannot be done even though it be perfectly understood. The area chosen, therefore, should be so limited, that by reasonably diligent work during the time assigned the purpose may be accomplished. The time assigned for the work should not be so long as to exhaust the child's interest, for it must always be remembered that we are dealing with children with all of the limitations of childhood. The area should have fairly definite boundaries so that there may be no probability of confusion in comparing results. Fences, streams, roadways, indeed any well marked local features will serve to furnish such boundaries. As a rule the area selected is far too large and the child is so overwhelmed with material that he is helpless in the presence of his problem. Almost as many trips are valueless because of the too large area assigned as because of the too large purpose. The area selected should be such as well illustrates the purpose selected and this indicates that the teacher must have determined both purpose and area by a previous study of the region. This means work, but success of any kind means antecedent work and the field trip in nature-study furnishes no exception to the rule.

The reports of such trips should be brief, yet comprehensive and of such character as to be easily comparable. Their form will necessarily vary with the purpose and the age of the child, but in every case they should be of the character indicated. Essays upon the trip, stories about special objects seen are perhaps to be encouraged, but these should not be considered as in the nature of reports. Let us assume a field trip for children of the second grade, having as the area chosen the school-yard, and as its purpose the number of kinds of trees that can be distinguished by the foliage leaf. As a preliminary have the children determine the exact number of trees in the yard. After this the determination of the kinds recognizable by the leaf may be worked out. The report may take some such form as the following:

Number of Trees	25
Maples	10
Elms	7
Poplars	5
Oaks	3
	25

The names are given merely for convenience; the report might show, instead of the name, a leaf of each kind recognized pinned upon it with the number beneath. If different results are given do

not correct, but have the pupils making different reports re-examine the area and correct or verify their own work. Such a report is of the simplest, yet it completely covers the purpose of the trip and is in such form that a clear notion of the work of each child may be quickly obtained.

In some cases it might be well to have a map of the area made by the child, and the position of the trees roughly located. The chief objection to this form of report lies in the fact that the teacher is more apt to determine the value of the work by the excellence of the map than by the discrimination shown in distinguishing tree forms by the leaf. Apart from this objection such a form of report has many advantages and appeals strongly to children of the second and third grades. Even a rough map is perhaps beyond the ability of first-year pupils. Incidentally the habit thus formed of mapping areas studied will be found to be of constantly increasing value as the work progresses.

Of course the work with the trees of the school-yard is not all completed by this study; it is but one of many field trips to the yard, each of which is to ask of the trees some definite question. The example, however, illustrates fairly well a typical field trip, that is one having a definite purpose easily within the grasp of the child, a definite and limited area at a reasonable distance and one which well illustrates the purpose of the trip.

METHODS OF TEACHING NATURE-STUDY

BY A. J. GROUT, Ph.D.

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Since the term nature-study is variously interpreted, it may be well to start with a statement as to what the term signifies to the writer. It means to him the study of natural objects and their relations in a way to appeal to the sympathies and develop the interest of pupils, young people especially, but also people of a more mature age who for any reason do not care for more formal scientific studies. Nature-study may be stretched to include lessons in inanimate nature—such as stones, minerals, and simple lessons in elementary physics and chemistry—but the term has been more generally limited to the study

of living beings, animals and plants. It is the latter meaning that is held in mind in this paper, although the same general principles would apply to the wider interpretation of the term.

The difference between nature-study and elementary biology is not clear to many people. Personally the author believes they should not be differentiated but should become synonyms. Elementary biology as now taught in our high schools differs from nature-study in that nature-study is concerned most with the pupil, while elementary biology seems most concerned with subject-matter, i. e., most concerned that the subject be presented in as complete and systematic a manner as possible, without properly considering the needs and desires of the pupil.

Most writers on nature-study emphasize the fact that it is less systematic than elementary biology, that it deals with objects that readily come to hand. It is true that it should deal with objects as they come to hand, any striking or interesting bit of experience of the pupils with natural objects, or any unusual or heretofore unnoticed objects or facts should be fully utilized at once, but to realize results of the most lasting value there must be a well developed plan in the teacher's mind into which these apparently unconnected facts must be worked to give a connected and comprehending view of nature to the pupils. The teacher must build in her mind a cabinet and see that the facts as they come in are placed in their position so that when the cabinet is full the view of nature which she desires to present will have something of completeness and unity. Without this, nature-study is likely to degenerate into sentimental superficiality, destructive both to interest and intelligence.

In a graded school it is specially important that some well defined syllabus be planned and used to avoid loss of interest through wearying repetition. What criticism can be too severe for the school in which a child of the sixth grade remarks with contempt as the tea-kettle is brought in for the science lesson, "The same old tea-kettle that we have had every term."

Before proceeding to discuss methods in detail let us consider what we wish to accomplish by lessons in nature-study. The writer's aim has been to teach so that the pupil will have the desire and the ability to learn more. School life at the most is only a few years and what knowledge we can impart is in itself insignificant as to quantity, but if we can make the quality such that it shall lead to continuous and pleasurable additions throughout life we have enriched and ennobled

the lives of our pupils; have made petty narrowness of life, pessimism and ennui almost impossible.

But let it be understood that the ability and the desire to know more cannot be acquired without the acquirement of facts, of habits of observation and reflection about facts, and of habits of inquiry into the reasons for facts. The sympathy with nature and interest in her ways on which other writers so strongly insist must also be present. Desire and ability to know are the first and great requirements that include all the lesser.

Professor Bailey gives the following as the three important parts of a nature-study lesson: the fact, the explanation of the fact, and the interrogation in the mind of the pupil.

In accordance with well recognized laws of mental development, the fact must be most emphasized in teaching very young pupils. As they grow older the explanation of the fact takes most prominence and with still older and more mature pupils the mental interrogation becomes of increasing importance.

It must be fully recognized by the teacher that generalizations, which are of supreme interest to intelligent adults, do not appeal to children to any great extent. One cannot appreciate general laws until the facts which the laws connect are acquired. One does not perceive the necessity or utility of a string when one has but one or two pearls. It is agreed, practically without exception, that nature-study to accomplish its purpose must interest the pupil. Interest, outside of subjective tendencies, as in all other cases, is principally dependent upon two factors, the facts presented and the method of presentation.

There can be but little doubt that the method of presentation is the most important factor in arousing interest, as we all know by personal experience. It has even been said with a show of truth that many people prefer nothing said gracefully to the most weighty statements blunderingly expressed. Nevertheless we must remember that there is a difference in the facts themselves and out of nature's inexhaustible storehouse of material it behooves us to display to the child those treasures of the most intrinsic interest.

In the author's own experience he has found that certain things always interest while others of equal importance in themselves appeal to but few, even with his best efforts.

With the young child names of common objects or of the parts of objects are learned most readily and nature-study in the kindergar-

ten and the lower primary grades may well consist largely of learning the names of plants and animals and their more important parts. The names of birds and of the most conspicuous insects and flowers will prove interesting even at the high-school and college age. Names must be learned, for we can as readily talk about things we cannot name as we can express ideas without words. Until this teaching of names is more generally done in the lower grades than it has been in the past, it will be necessary for the upper grades to have a larger amount of this instruction than rightfully belongs to them. Animals are of greater natural interest than plants. Children like action. No toy so pleases as the mechanical toy that "goes of itself" or the doll that can cry and shut its eyes. The mother-bird feeding her young, the insect visiting the flower, the caterpillar changing to a butterfly, the tadpole changing to a frog, are all objects of perennial interest to the child. In country schools such observations are readily made on wild animals in their natural habitats. In city schools pets in confinement and visits to parks and zoölogical gardens offer a substitute, poor by comparison, yet of great value.

In watching the actions of animals and indeed in all nature-study dealing with action we must remember that repetition is not distasteful or uninteresting, if the child be naturally interested. It is a common thing to have a child ask for the same story or the same trick, time after time for many days. To know how the story or act is "coming out" does not apparently detract from the interest of young children but rather adds, as it gives a pleasurable feeling of power to be able to forsee the next event. The tenth butterfly coming out of its chrysalis will be watched with almost as much eagerness as the first.

Plant life also has its motions and these always appeal to children. The closing of flowers and the drooping of leaves at night, the explosive dispersal of seeds, the turning of leaves towards the light, and most of all the beautifully marked actions of the sensitive plant (Mimosa pudica) never fail to arouse interest and hold attention. The seeds of the sensitive plant can be bought of any large dealer in seeds and will grow readily in gardens from late spring until frost. I have disposed of dozens of packets of the seed for this purpose. Not all succeeded with them, but neither would they all succeed with radishes or corn.

One reason that the actions of the sensitive plant arouse so much attention is that motion is an unsuspected power of plants and also quite unusual. Unusual things and little known facts about

common things are two classes of facts that one can usually rely upon to serve his purpose in nature-study. The latter class is so large, so easy of access and so provocative of individual observation that it should furnish a very large proportion of the subject-matter. If the child be an East Side or a North End tenement dweller he can at least learn of flies and spiders, dogs, cats, horses, geraniums and Chinese lilies.

The age when the child who knows that the chestnut-bur is prickly and the acorn bitter is able to appreciate the reason why, varies with different individuals but the observant teacher will have no difficulty in seeing whether or not her class is ready for much work in the reason why.

Many facts of great interest to adults are beyond the comprehension of any but the older pupils. Such are the various devices for securing cross-pollination in flowers, mimicry and protective coloration in animals. The young child can readily see that the stamens mature before the pistils or that the grasshopper is of the same color as the sand on which it lights, and he may seemingly comprehend when you tell him that the pollen cannot reach the stigma of its own flower or that the bird cannot see the grasshopper to catch it, but the full import of these facts may be beyond his comprehension and may not appeal to his imagination or interest in any such degree as to an older person. With the older pupils and with adults, facts showing an adaptation of means to end have a great and increasing interest. Such are the ovipositor of Thalessa, the hollow bones of the bird, or the beautiful treacherous leaves of the sundew.

To sum up: Our facts should not be too familiar. They should be suited to the age and mental development of the pupil. Observations of active life are of greatest interest to children of all ages. New and unsuspected things about common objects should constitute a large proportion of the work. Marvelous and striking facts are legitimate and highly useful material. Adaptations of means to end appeal with increasing force as the pupil grows older.

The general method advocated by Professor Bailey is very useful. Bring in an object, say a flower, and ask the children to look it over carefully. Then ask each one what he sees. Everyone will note the bright colored corolla but many will see no difference between stamens and pistils. Create a spirit of emulation to see who can see the most things and the most important things. Some pupils will always be seeing the hairs on the stem before they see the essential

organs. Next it will be well to examine several flowers to see if all have the same parts. Those that are most often absent are likely to be least important. Next it may be well to devote some time to a discussion of the relative importance of the facts observed. This will necessitate the discussion of the uses of the flower and its parts.

If a plant can be obtained that has both flowers and fruit at the same time it is easy to infer the use of the flower. The use of the pistil will readily be apparent, but stamens and petals will need more time and further observations on the visits of bees and the like. How does the insect find the flower? For what does he visit it? What does he carry off on the hair on his legs? Does he visit any flower that comes in his path or does he visit flowers of one kind only?

While animals are as a rule more interesting than plants, plants have the great advantage of availability and it is possible for each child to have a specimen. Where the school-garden is present it affords the ideal facilities for nature-study and for making the connection between nature-study and the other interests of life.

The germination and growth of the seeds and the care and development of plants cultivated *for a purpose* have an interest that seeds germinated in a pot to be pulled up and examined can never have. The appeal is here to the practical side of the child's nature, to that which impels him *to do* something that will produce concrete results that he can utilize for his own needs and pleasures. Hardly will the seeds have started before the weeds will appear and will have to be combated. Naturally the child will learn the names of the weeds and also which kinds are most troublesome. Then he will want to know *why* they are so troublesome. What characteristics have they that enable them to thrive and crowd out his cultivated plant unless combated with energy on his part? Then insects will attack his plants, eating root, stem, and leaf, flower and fruit. From this the child will learn naturally the name and life-history of the most common and familiar insects. He will learn to distinguish beetle from bug and moth from butterfly as naturally as he learns to know dogs from cats or horses from cows.

Easily also the child will learn to discriminate between enemies and helpers, he will learn that lady-bug and tiger-beetle, dragon-fly and toad are valuable assistants, to be encouraged and helped. Birds will readily be seen catching injurious insects and will be given a place as helpers. This will naturally again lead to learning the names of the helpers and a desire to foster and protect them. A further

observation of their home-life will serve to establish a permanent bond of sympathy with the friends in feathers. The boy who has seen a robin taking injurious insects from his garden to feed its young will hardly shy a rock at it on the sly even if it does eat a few berries in berry time. Also, when he finds his pet cat with a bird friend in its mouth he may begin to suspect that puss is really an enemy in disguise. Let us hope that after a little education of this sort for the rising generation we may not always have the same difficulty in getting rid of the cat nuisance, whose assistance in scattering disease is more objectionable even than its destruction of birds.

Often some of the most interesting lessons are on material brought in by the members of the class or on observations made outside the school by some of the pupils, or on something that occurs near the school. One progressive teacher in the suburbs of Boston stops her recitations occasionally to listen to the bird songs outside. One of the best bird lessons for small people that I have ever seen was given to a class in gardening when it happened to be visited by a vireo, a humming bird, and a warbler all at once. The method of systematizing these observations has been previously discussed.

To learn the names of plants, and of insects and other animals easily caught, is easy, but with birds it is more difficult. Bird skins can be used, but good colored pictures are preferable for ordinary use for reasons both sentimental and practical. After learning the appearance of the bird it is quite easy to learn to recognize it in the field.

Bird study out-of-doors is best begun in winter or early spring when species are few and all can easily be learned, both notes and plumage. When the migration sets in in the spring, the new arrivals are readily recognized as new and many can be learned the first season, by the teacher at least, by the aid of a good bird calendar like that in Chapman's "Handbook."

The directions usually given in bird books to take a note-book and make careful notes of every bird seen may be good practice for the teacher, but if carried very far with her pupils is guaranteed to kill their interest in birds. Notes on a rare or difficult stranger are at times necessary, but to write out a full description of every bird you wish to identify is like analyzing your dessert before you eat it. If one guesses wrong the first time, subsequent observations will correct the error. Indeed the whole secret of knowing the birds is repeated careful observations and a comparison with specimens or descriptions until certainty results. The pupil should be taught to look for the most

striking and distinctive markings of a species at first sight and then fill in details as occasion permits.

The methods suggested here or elsewhere are of secondary importance when compared with the teacher's own attitude towards nature. Many teachers will attend lectures on nature-study, take nature-study lessons and study nature-study books, but never study nature herself, or only incidentally. Let the teacher attack some side of nature-study herself as independently as possible, the birds or flowers of neighboring fields or parks, the common trees or some order of insects. Let her persevere until the first somewhat difficult and discouraging steps are taken and the first dozen birds, flowers or trees learned, and new ones will be located with comparative ease. Then she will have done more to make herself a good teacher of nature-study than all the books and all the lectures in the country could have done, without this action on her part. Of course it is understood that learning a bird does not mean merely learning its name, but learning its habits, its song, and if possible the peculiarities of those individuals most easily accessible.

A teacher who has not enough interest in nature to study some phase of it for herself *can not succeed* in interesting children in nature. Let her become an enthusiast and her pupils will take as naturally to nature-study as they will to skipping the rope or playing ball.

The author has given nature lessons to many teachers who say they have not the time to work up the material for themselves and that a good lesson or lecture saves them so much time. There is truth in this, but the tendency is to lean too much on this sort of help and to look at the work done as merely preparation for routine drudgery rather than an addition to personal culture. Help enough to enable her to help herself intelligently is all the assistance an earnest teacher should seek.

The children will enjoy learning with you. The author has done some of his best work in bird study with boys who knew only a little less then he. Together we worked out our problems and solved our difficulties. They not only learned but learned how to learn, and the latter was by far the greater gain.

THE WEAKNESS IN TEACHING NATURE-STUDY

BY WILLIAM T. HORNADAY

Director of New York Zoological Park

[EDITORIAL NOTE.—This paper by Dr. Hornaday is so full of ideas radically opposed to those commonly accepted by science teachers that it will certainly set many readers of THE REVIEW at work defending their own views. Have we been going to an extreme in basing our modern teaching on actual perception of natural things themselves, and have we not neglected books too much? This is the problem which the following article sets before us. It deserves discussion. Perhaps there is a 'golden mean between two extremes" represented by observational study and book study.]

At this hour the most interesting and far-reaching study in which a naturalist can engage is—why "nature-study is still so disorganized, and so far from being firmly established in our school system." This question is taken from the editorial admission in THE NATURE-STUDY REVIEW, May issue, page 169.

Beyond doubt the state of fact presupposed by the question really exists. To an interested bystander it seems that the teachers of the kaleidoscopic things called "nature-studies" are, as a mass, groping in Egyptian darkness for the method which shall be to them all a pillar of light. It also seems that some of the reasons for this are so plainly evident that they should be apparent to all.

In the first place, all over this broad land—where up-to date-methods prevail— the teachers are struggling to do the work that forty years ago was demanded of the pupil. Take geography, for instance. The modern method practically requires the teacher to marshal facts by the thousand and place them by his own efforts within empty minds. Instead of starting with a bird's-eye view of the world and gradually coming down to small details, the pupil must first be taken out and shown the marvels of his own town, the wonders of his own creeks and hills. In American schools much valuable time is wasted in solemnly teaching things that all pupils who are not idiots would be bound to learn early without a teacher and school "periods." The great round world is approached by a long series of stealthy flank movements, chiefly at the expense of the teacher.

Teaching from the object has become such a fetich that it is worked beyond its legitimate limit. By many the text-book seems to be regarded as the pupil's last resort, a sort of necessary evil. Memorizing from a book has been replaced by the talk of the teacher, and the scanty scrawls, called "notes," made by the pupil. I have seen

nature "notes," made by high-school pupils, that were truly a sight to behold.

The present methods of teaching geography have been grafted bodily upon the teaching of nature-study. No less a man than Professor D. Lange gives this definition: "*Nature-study means getting acquainted with life about our homes.*" There are scores—possibly hundreds—of teachers who are attempting to live up to that principle; and a more inadequate foundation for zoölogical work could hardly be devised. It means a limitation that is pitiful. Forty years ago geography was taught wholly from text-books and maps, and it was learned—as I have reason to believe—far more thoroughly and successfully than it is to-day. Nature-studies can be taught to-day from text-books and pictures, just as well as geography was taught in the '60's. There are millions of children who have *no* "life about their homes!"

The first need of the hour is a proper nature text-book, which sets forth the facts about animal life that every young person needs to know, both for actual use, and in order to not be grossly ignorant. These facts should be set forth according to the system of nature, not by mixing up all living things—birds, bugs, flowers, mushrooms, shells, crabs and trees—in a chaotic mass.

The pupil should be required to memorize facts and definitions from his own book, not from the lips of a tired and over-burdened teacher. The available objects of natural history should supplement this work; but the mice and beetles and sparrows and dog-fennel that surround the "little red school-house" should not be set before the pupil as the leading representatives and exponents of the great living world.

The more the nature-study teachers of America strive to ignore the *system* of nature—the key to all successful zoölogical work, great or small—the more will they grope in darkness, the more will their work end in child's play. Any sensible child ten years of age can learn, and remember for use, a certain number of the grand divisions—the continents, as it were—of the animal kingdom. As they grow in intelligence, they can build on this foundation. Moreover, the average teacher surely will enjoy teaching a rational, clear-cut, progressive system.

But *the pupil must be made to do the work.* Have done with the everlasting coddling that compels the teacher to do everything that savors of work! Young naturalists can not be made by the oral fun-

neling of facts into empty heads. They must dig, or they will remain ignorant! And to do this, they should have such a text-book as has not yet been written.

The ideal text-book should be written by a practical teacher, who is capable of taking a broad survey of the whole field of nature, and who will not handicap his work by overloading it with his own favorite subject. Do not try to handle botany and zoölogy in the same volume; for an angel from Heaven could not do it successfully. In zoölogy, anatomy should at first be severely and resolutely let alone! And give up, once for all, the mistaken and pernicious notion that the natural object is everything, and pictures and diagrams are nothings. In spite of Agassiz, American children are not such idiots that they can not learn continents and states from maps, and living things from pictures.

The utterly sinful waste of school time on such studies (!) as those listed under the head of "Clothing, How to Dress Properly" in THE REVIEW, (May issue, page 165), is a subject by itself; yet it deserves to be reckoned with in solving the nature-study puzzle. If the dead wood ever can be cut out of modern schoolcour ses of study, the school pupil will have ample time to learn something worth knowing about the most important zoölogical forms of his own country.

American educators may try all they please to evade the necessity of teaching animal and plant classification as the bed-rock foundation of their work, even in the upper grades of the grammar schools; but the final result is inevitable. The processes of nature can not be reversed by the fiat of a board of education. The multiplication table must be learned before the pupil can successfully cope with percentage. Even a Bornean head-hunter knows better than to attempt to put doors and windows in his house before he has built the foundation and erected the walls. And yet, there are hundreds of persons who believe that in an exposition of animal life the teacher can begin wherever he pleases, and leave out everything that does not happen to strike his fancy, or that does not live in his own bailiwick.

In recording these views, I am assuming that the nature-study to which this journal is devoted is serious work, for pupils of reason and sense, and not for primary department children who are too small to use text-books. I have not attempted to sugar-coat too deeply what I have tried to say; for it seems to me that the time has come for plain speaking. If my views meet with no concurrence and less sympathy, I will at least be able to feel that I have conscientiously posted this warning.

NATURE-STUDY

BY S. ARTHUR JOHNSON

Professor in Colorado State Agricultural College[1]

It will be impossible in the time allotted to discuss this subject in detail, so I have contented myself with presenting outlines.

"Nature-study is primarily the simple observational study of common natural objects and processes for the sake of personal acquaintance with the things which appeal to human interest directly and independently of the generalizations of organized science." (M. A. Bigelow in NATURE-STUDY REVIEW, Jan., '05)

In the beginning of this discussion permit me to express the belief that the subject is well defined in its title. The very mention of nature-study without further explanation has had the electrical effect of a magic wand, both in pedagogical and home circles. Evidently the idea, however vague it may be, and in spite of the multitude of phases it presents to individual minds, has in it a germ which will, we hope, conquer some human ill. Around this thought has clustered a host of ideas and about it has grown up a literature which cannot long escape being incarcerated behind the bars of Barnum's circus. Taken in toto it is the only living "what is it" of this end of the century. What, then, is the real kernel of the subject? Is it not to be found in the words of our text, "the common natural objects which appeal to human interest?" This interest may be scientific, educational, utilitarian or aesthetic, but it must be human.

If this assertion is correct, will it not help us to unravel some of the knotty problems of method and subject-matter?

The writer once asked a zoölogy teacher where to begin teaching the subject. He replied, "with whatever you have at hand." Huxley for a number of years taught zoölogy students by beginning with the single celled animals and proceeding to the more complex. This method seemed right in view of the science and commended itself from the standpoint of theory, but the practice was not so successful. He found that the moment a student put his eye to the microscope he was introduced to a world with which he had had no previous

[1] Read before the Northeastern Colorado Teachers' Association, Greeley, April 13, 1906.

experience. As a consequence he was much at a loss to know how to understand it. The problem was solved by taking the students back to the ground with which they were familiar and proceeding thence into the unexplored territory.

A second reason is quite as valid as the above. The animal or plant to the child mind is as much a unit as a single celled protozoan. There are no more parts of a frog in the estimation of the novice than the scientist sees in the single celled animal. We would suggest, without depreciating the study of anatomy and histology in their proper sphere, that the preservation of the idea of the unity of the organism is of considerable importance. In practical experience and for all purposes which serve a general human interest it must be considered as such. This is not saying that the child should not be taught that a plant has leaves, stem and root; or that a bird has feathers, feet, beak and wing; but that the essential unity should not be lost to view. This view may be best preserved, perhaps, by dwelling on the purpose of each part in the life of the organism.

All of these considerations point to the conclusion that nature-study must to a very large degree be a local problem. It must be solved for each locality, and modified to suit each school district. This is one of the reasons, at least, why no general course of study has been universally successful. They have been arranged on popular and scientific plans. They have been logical and consecutive or heterogeneous. They have been easy and difficult. While most of them have been helpful and useful, none of them can be termed successful in the same sense that we would apply the word to text-books on any other subject in the curriculum.

The rest of the subject very naturally divides itself into the questions of the teacher's equipment and the course of study.

In the former case will it be trite to say that it cannot be too large? We would hesitate to say this, were it not an altogether too common thing for education to be required in every other subject and to assume that nature-study may be taught without training, without equipment and without leadership. We have been surprised that the shores of our educational seas have been strewn with the wrecks of this particular kind of educational craft. On the other hand ought we not to wonder that so many have come safely into port? Sailing as they have without chart, compass, or pilot and in many cases without even a rudder; blown about by every wind of doctrine and becalmed in the belt of perplexity, is it not a marvel that we have saved so much?

This fact itself speaks volumes for the content of the subject and gives courage which would otherwise be hard to entertain.

The most valuable asset in equipment is sympathy. This is the keynote of success in our dealings with the world about us. It unlocks the doors of treasure vaults in scientific research. In so far as the scientist is able to divest himself of himself and imbibe the spirit of the thing which he investigates, in just so far is he making himself capable of interpretations which are of real and permanent value. When the farmer comes into sympathy with the soil and learns that his business is not all a game of grab, but that the soil must be ministered unto, then will he reach the condition where it will return to him his richest harvest.

So the teacher in sympathy with nature is thrice armed. He enters into her moods; learns her facts, open or hidden; and peers into her future with prophetic eye. How can we attain this? To some souls it appears to be given as a benediction from above; to many it may be secured by contact with the things themselves; for the rest it may cost conscious effort and exercise of will.

The second element in equipment is scientific knowledge. First place must be given to facts. Cold and hard and uninviting as they may be, they are the foundation stones upon which we must build. To them we must always return when the tempests have scattered our castles in the air. Second in importance we shall place the great principles of science. The master minds have given us these as the yard sticks with which we may measure the facts about us. Third, a mastery of the scientific method. The psalmist wished for the wings of the bird and bequeathed to us this legacy. How much that is false and visionary might have been avoided, how much of human suffering, how many blasted human hopes might have been averted if men had known how to interpret the world about them? Much of nature-study, so called, must fall to pieces because it will not withstand this battering ram of modern thought.

The third element is pedagogical method. It is not our purpose to discuss this problem further than to call attention to a distinction which may be helpful. The ordinary science teacher teaches from the standpoint of his subject. That is his center. He seeks to find the light which will make his subject visible to the pupil. That is one reason why so many students find science studies uninteresting, not from any fault in the subject or the pupil, but because the line

of communication has not been established. In nature-study the child must be the center.

Time forbids that we should do more than mention the factors in the course of study. All of the previous discussion will mould and limit what may be suggested here.

A complete course of study extending from the primary to the high school would be eminently desirable, and such may be ultimately possible in general broad outlines with certain conditions, and in limited localities. Some of the fields of nature-study bend more readily, into such an outline than others. Such, for instance, would be the realm of physics. In most biological lines, however, a modification must be followed.

The teacher facing the necessity of teaching nature-study would do well to make a preliminary survey of the field. This completed, the second step would be the selection of one or more problems. Much of the success will depend upon the care and wisdom of this action. The problem must be one that is worth while, one that has sufficient content to stimulate thought and interest. It must lead somewhere and the end must be worth the journey. Few adults would be content to hunt needles in a hay stack and I see no reason why children should be employed in that pursuit. Much of our nature-study results in the gathering together of quantities of heterogenous material which have neither beginning nor end, except in the waste basket, and would have served the world better had it been returned to the soil by the action of the elements. It would be better to study one plant from the germination of the seed to fruition than the comparative germination of twenty different kinds of seed.

This implies, of course, considerable time and preparation on the part of the already overburdened teacher, but, after all, it is not the number of lessons but their content that is of real value. One good lesson a month is of more worth than two each week which are "frazzled out" at both ends and so weak in the middle that they will not bear the weight of a pointed question.

In this connection we should mention the animal story. There is no objection to entertaining the scholars at times in this manner. The serious trouble with it that it is too easy. We must not deceive ourselves with the notion that this is true nature-study unless these stories have a direct bearing on the problem in hand.

In all our work we must seek to train in habits of exact observa-

tion, in drawing of legitimate conclusions from the data at hand, and fidelity to the truth in whatever form we may find it. For the one question that confronts us at all times and everywhere is not "what have we always thought this thing to be?" or "what do we hope it is?" but "what is it?" The individual who rightly answers this question in whatever walk of life he may be found, is the one who writes "success" at the bottom of the page.—[*The Colorado School Journal.*]

CANADIAN DEPARTMENT

EDITED BY PROFESSOR W. LOCHHEAD

Macdonald College, St. Anne de Bellevue, Quebec

[All communications relating to nature-study (in the broadest sense) in Canada should be sent to the editor of this department at above address.]

A SCHOOL OF AFFAIRS

I like Professor Bailey's "School of Affairs."[1] It appears to be a most rational method of educating rural children, for the activities of the school district are made the means of training. I have all along felt that the term nature-study was too narrow, and that it took for granted (suggested at any rate) that the objects studied should be mainly plants, animals and rocks. These do not make up the home world of the country child, neither do the interests of the country child belong entirely to the field of nature. The cheese-factory, the creamery, the silo, the farm drainage, the construction of roads, the brick-yard, the quarry, the orchard, the fruit evaporator, the cement works, the making of concrete, the building of barns and stables, the water supply, the grist mill, the foundry, the breeds of cattle, sheep and swine, crop rotation and commercial fertilizers, etc.,—all these are of interest to the child at some stage of his school life, because these are the activities of his environment and have become "part of him."

This "School of Affairs," too, is supremely natural, for the training received there has direct reference to the needs and conditions of the neighborhood. The children of such a school are brought into direct touch with things and events close at hand. They get that education which is described by Dr. Jas. W. Robertson as a series of experiences leading up to the possession of certain powers—ability to do work, intelligence regarding the common things of rural life, and thoughtfulness for others' welfare.

The school-garden works wonders, but the broader agency of the "school of affairs" vitalizes the whole school course. It will be con-

[1] See "The Outlook to Nature," Chapter III.

ceded by most teachers that the method of nature-study is gradually revolutionizing the methods of teaching the ordinary subjects of the school; and I believe that if the broader meaning of nature-study as indicated above were more fully understood and were acted upon by our teachers, public opinion would soon compel the framers of our school curricula to make nature-study the real basis of our school effort, and to relegate the present unnatural course to the museum of antiquities.

The Macdonald movement in Canada is an effort to construct something better along educational lines than that which now obtains in rural districts. "The movement has nothing destructive in it. It does not desire to destroy anything good that now exists, but it hopes to construct something better and thereby displace what is poor. It aims at helping the rural population to understand better what education is and what it may do for them and for their children." One feature of the movement is to show the value of consolidation of schools by the establishment of rural consolidated schools, well equipped with competent staffs for teaching, along with the ordinary subjects, manual training, domestic science, and nature-study where school-garden work is emphasized.

In most of these Macdonald schools the term nature-study has been given the broad significance with the most gratifying results. These schools might in all fairness be called "Schools of Affairs."

At the Consolidated School, Guelph, Ontario, an effort was made last winter by the principal, J. W. Hotson, to gather in the larger boys who would not attend a smaller school presided over by a female teacher or by a male teacher of very limited experience, and to give them instruction along practical lines which would appeal especially to farm life. The boys responded to the appeal, and a class of twelve young men, ten of whom were over twenty years of age, was formed under the direct charge of Mr. Hotson himself. The course was to last six weeks, but owing to the interest taken, it extended over three months, or until farm operations required their attention at home. From personal observation of the work that was done I agree with Mr. Hotson that the results of the experiment were among the most encouraging features of the consolidation experiment at Guelph, and that this course has done more perhaps to popularize consolidation than any other phase of the work. Following is Mr. Hotson's synopsis of the course offered:

Without going too much into detail, this course included reading, writing,

spelling (with special reference to words that are met with every day in connection vith the farm and the home).

Arithmetic—Problems relating to the farm where measurement of material, extension, capacity, etc., are required; interest; discounting notes; surveying and measuring land; estimating distances and areas as foot, yard, rod, square rod, acre, ten acres, etc., and verifying these by actual measurements.

Bookkeeping—Practical method of keeping farm accounts so as to be able to ascertain accurately the cost of any given product during any given period of time; business forms; contracts; notes.

Farm Operations—Tying various kinds of knots—overhand knot, square knot, granny knot, weaver's knot, double sheet bend, two half hitches, anchor knot, clove hitch, timber hitch, bowline, etc.

Splicing of ropes—short splice, long splice, eye splice. Grafting, making grafting wax, root grafting, whip grafting, etc.

Construction and operation of a common suction pump.

Drawing—Drafting in connection with the models in manual training; making plans and specifications for a barn and stable suitable for a hundred acre farm (average size in this vicinity).

Agriculture—Stock judging once a week for eight weeks; simple experiments with p'ants; study of the common grasses and clovers; weeds and weed seeds especially those mentioned in the Seed Control Act.

Elementary Physics and Chemistry—Practical uses of the forces of nature with problems connected with them, as the force of running water, the force of wind, etc.; economical application of force in farm machinery as the lever, wedge, crow-bar, use of jack screw in raising buildings, pulleys. Physical analysis of soils, experiments in soil physics. Chemical and physical changes that take place in the earth, air and water, with special reference to things of the farm and the household.

Civics—Municipal, Provincial, and Dominion governments and the machinery of government connected with each.

Manual Training—Construction, use and care of the common tools. Recognition of common trees; cutting, sawing and seasoning lumber; a simple working drawing plan and elevation; a course of models consisting of churn-handle, file-handle, ax-handle, hammer-handle, picture-frame, hat-rack, paper-knife, checker-board, book-shelf, bread-board, bird-house, small wall-bracket, corner bracket, construction of seed-cases to hold the 23 weed seeds of the Seed Control Act.

Local Industries - The limestone quarry, the dairy, the oat-meal mill, the Winter Fat Stock Fair, the pipe mills, the agricultural implement works, etc.

Mr. Hotson writes: "It is hoped that by another winter this course will be improved and extended so that even better opportunities will be offered; and it is confidently expected that there will be a large increase in the number attending it. It is also contemplated offering a similar course for the large girls of the section."

W. LOCHHEAD.

CANADIAN NEWS

Mr. E. A. Howes of the Bowesville Public School has been appointed Principal of the Macdonald Consolidated School, Guelph, Ontario, *vice* Mr. J. W. Hotson, M.A., resigned.

Mr. Percy J. Shaw, B.A., Macdonald Travelling Instructor in Nature-Study and School-Gardens for Nova Scotia, has received the appointment of Professor of Biology in the Agricultural College, Truro, N. S. He will, however, continue to supervise the school-garden work.

R. H. Cowley, M.A., Inspector of Public Schools for Carleton Co., Ontario, has been made Inspector of Continuation Classes for the Province. Mr. Cowley has done much to introduce nature-study into the rural schools of his county, and his appointment is taken as evidence that the Education Department of Ontario is in hearty sympathy with the movement to educate rural children for rural life.

A strong effort is being made in the Province of Quebec to arouse the interest of the people of the rural districts in educational matters. A series of public mass meetings was held in August in about twelve of the rural centres, and these meetings were addressed by some of the most prominent public men of the Province. Consolidation of schools, increase of salaries of teachers, and better preparation of teachers were strongly urged by the speakers. It is likely that considerable attention will be given to educational reforms at the next meeting of the Legislature.

The new Macdonald College, now in process of erection at Ste. Anne de Bellevue, near Montreal, will give much attention to the training of teachers for the rural schools of Quebec.

The Annual Educational Convention of the teachers of New Brunswick was held in Chatham, June 27th-29th. The discussions that took place during the sessions regarding the place of nature-study in the course of studies, revealed the fact that many of the inspectors are in hearty sympathy with the new movement, and have introduced school-gardens, etc., as part and parcel of the school work. The influence of the Macdonald Consolidated School and school-gardens has been marked in New Brunswick.

Professor S. B. McCready, Professor of Nature-Study in the Macdonald Institute, Guelph, Ontario, has become Professor of Botany in the Ontario Agricultural College, Guelph. He will continue in charge of the Nature-Study Department.

Four additional Normal Schools for the training of teachers in

Ontario are to be erected during the coming year—at Hamilton, Stratford, Peterboro and North Bay. More attention is to be given in these new Normal Schools to the preparation of teachers for rural schools. Nature-study will receive increased emphasis.

CRICKETS FOR STUDY IN THE SCHOOLROOM

BY FANNIE A. STEBBINS

Supervisor of Nature-Study, Public Schools, Springfield, Mass.

I have written the following from notes given me by the teacher of one of our second-grade classes in which crickets were more interesting than any other thing studied last year. Teacher and pupils were alike eager and enthusiastic, always ready to tell what their pets had done. About the middle of September, twenty crickets, males and females, were brought to the schoolroom. A battery-jar, which had been cracked and so was of no further use as an aquarium, was fitted up for their home. This particular jar was about 12 by 11 by 9 inches, with flat sides and ends. Turf and soil to the depth of three or four inches were placed in the jar, the crickets were introduced and some mosquito-netting tied over the top to prevent their escape. The grass served as a partial supply of food, and the crickets also concealed themselves in it sometimes.

Feeding tests were made by the children, who supplied bread, cake, fruits, sugar, etc. In fact almost everything the children used as food themselves was offered to the crickets and the kinds eaten were noted. Soon after coming to the schoolroom the females began depositing their eggs, a process which the pupils watched, seeing through the glass the pushing of the ovipositor into the soil, or rather between the glass and soil, and the extrusion of eggs. Sometimes one only would be deposited in one hole, sometimes several. Of course some of the eggs were dug up and examined so that the pupils could surely recognize them when seen elsewhere. The eggs were usually deposited rather late in the afternoon, many times beginning about four o'clock. The jar was kept in the sunlight as much as possible and the males sang cheerily most of the time.

Those who have kept crickets in confinement have noticed their tendency to devour their comrades. These were no exception to the rule, although this was mostly done at night. By the last of October all the crickets were dead. As the grass had all been eaten and

fragments of food removed, nothing remained but the soil containing the very numerous eggs.

The jar remained upon a vacant desk not far from a radiator, where it had been placed so that the pupils might go, one at a time, and sit and watch the actions of the crickets. The soil was kept damp, and about 70° in temperature. Just before the Christmas holidays the first little cricket appeared. From then until April new ones continually hatched, the jar seeming fairly alive, crickets walking, running, burrowing everywhere. As soon as the first hatched, grass seed was sown. As this did not suffice when the numbers increased, oats were also sown and even their vigorous growth was kept well eaten down. Sweet corn was soaked and put in, the young crickets eating it before it had time to grow. Lumps of sugar, as wel as other foods which the adults had eaten, were furnished.

When first hatched, also just after molting, the young were nearly the color of the eggs, a rather light buff, sometimes tinged with pink or flesh color. The molting was seen many times, occasionally it took place upon the lump of sugar which afforded a good background. The change to black or dark brown was usually complete in an hour. The split skin was sometimes left on a blade of grass, but sometimes there was difficulty in getting free from the skin and then after the head and body had emerged, the hind legs might be pulled out and used in kicking the skin from the other legs.

At first there was no indication of sex, but in about eight or nine weeks the wing-pads began to show and at the next moult the females showed a short egg-tube which grew in length from a stubby little projection to the natural mature length. It was between eleven and twelve weeks when those first hatched showed their true wings and the males began to "sing." The first one, however, made a very slight sound as his wings were injured in coming out of the skin at the final molt.

Finally, the numbers decreased so rapidly that it was deemed best to let the crickets out in the spring instead of keeping them for the laying of eggs, as had been planned.

One child repeated the experiment successfully at home.

The jar should be kept free from superfluous food and well ventilated so that there will be no bad odors.

The teacher of the room says: "It is the most interesting thing I ever tried. I advise other teachers to do the same. The only trouble is that sometimes it is almost *too* fascinating.

REARING OF ROSES FROM CUTTINGS

BY ELIZABETH YODER

Class 1905, Los Angeles State Normal School

[The following article illustrates what can be done in nature work by an enthusiastic young teacher who is given perfect freedom. Miss Yoder had had some experience in raising roses at home, and for this reason chose this line of work with the fifth grade that she taught as a student teacher. From nurserymen and others interested in the culture of roses she obtained such information as she could, but many of the points noted in this paper were worked out experimentally by herself and the class. The members of the class wers enthusiastic and intelligent in making their experiments, discussing with the greatest interest the problems which arose. The results of this term's work, which Miss Yoder has here put into concise form, is a positive addition to our nature-study literature, giving as it does a working plan for any teacher who may be interested in the rearing of roses.—J. R. CROSWELL.]

A. Choice of Cuttings.—Cuttings must be healthy and free from scale. Cuttings of the most common roses are usually the most easily grown. The Duchess, the Olga de Wurtenberg and the La Marque are among the best.

B. Time of Cutting.—Cuttings to be used in schools should be made before the bushes put out leaves in the spring, or during any rest period. Soft wood, i. e., new growth, taken just before the buds set is often used where bottom heat can be applied in greenhouses but this is impracticable in schools.

C. How to Cut the Slips.—Many advocate cutting the slip off next the parent branch, taking the wood of the joint known as the "heel;" but a method which is equally successful and less extravagant is the following. Cut the branch into cuttings, letting the lower cut of each slip be just below a bud. Cut at an angle of about 45°. A cut at this point callouses better and the roots start more quickly than at any other point, because the branch is specially strong at the buds. The cut should be smooth and the bark unbruised. The cuttings from the lower end of the branch are somewhat stronger than those near the tip.

D. Length of Cuttings.—Cuttings one-half inch or more in diameter may be about eight inches long. The smaller cuttings should be shorter in proportion to their diameter. There should be at least two buds above the ground.

E. How to Start the Cuttings.—Put the heavy wood cuttings directly into the ground. The smaller cuttings should be placed in a box of sand to callous and be left there until the roots are well started. The sand should be as clean and as free from mica as possible. Care should be used in setting the cuttings, as forcing them into the soil bruises the edge of the bark. Have the children make holes, place the cuttings in them then fill them and press the soil in firmly. Emphasize planting the cuttings half their length in the ground, for most children are not inclined to bury them deep enough. Care should be taken that the cuttings are set right end up; otherwise they will die. Not only children but even helpers in the nursery are likely to set them wrong end up.

F. Care of Cuttings.—Keep the ground damp but not wet. If the sun is warm, partially protect the cuttings, for the direct sun makes too great a difference between the temperature above the ground and that below, and the energy of the cuttings goes to advance the growth of the buds at the expense of that of the roots. During the first two or three days place newspapers or other good protection over them.

G. Large and Small Cuttings.—There are advantages and disadvantages of each. Large cuttings start more slowly than the small ones. Small cuttings start quickly, but are more uncertain unless on bottom heat in greenhouses. Small cuttings are best to show development.

H. How to Watch Development of Cuttings.—Put a small wood cutting into a flower pot of damp sand. To examine the underground developments, tip the pot upside down, emptying the cutting and sand into the hand. If emptied into the hand there is less danger of injuring the cutting than if tipped out elsewhere. In tipping the sand out, there is little friction between the cutting and the sand, hence there is but slight danger of rubbing off the callous and the starting roots. Keep the cutting damp while it is out of the ground for examination. The callous will be formed fairly well for the first examination about six days after the cutting is put into the sand.

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CONTENTS OF No. 1, JANUARY, 1905

Nature-Study and Natural Science—A Symposium, H. W. Fairbanks, C. F. Hodge, T. H. Macbride, F. L. Stevens, M. A. Bigelow. Physical Nature-Study, John F. Woodhull. Nature-Study and Elementary Agriculture in Canada, W. H. Muldrew. Some Recent Criticism of Nature-Study, F. M. McMurry and H. E. Armstrong. Agriculture in Southern Schools, C. W. Burkett. School-Gardens at Hartford School of Horticulture, H. D. Hemenway. Ant-Nests for Schools, Adele M. Field. Guide to Periodical Literature, Ada Watterson.

CONTENTS OF No. 2, MARCH, 1905

Educational Values and Aims of Nature-Study, S. Coulter, H. W. Fairbanks, M. A. Bigelow. Principles of Nature-Study, J. M. Coulter. Children's Gardens at Worcester, Mass., Illustrated, Edna R. Thayer. Why Some School-Gardens are Failures, T. R. Croswell. Chemical Tablets for Feeding Plants Growing Without Soil, Illustrated, Edward F. Bigelow. A Nature-Study Lesson with Moulds, F. L. Stevens. Nature-Study in High Schools, M. A. Bigelow. Guide to Periodical Literature, II., Ada Watterson.

CONTENTS OF No. 3, MAY, 1905

Why Many Fail in Teaching Nature-Study, L. A. Hatch. Ready-Made Lessons in Nature-Study, L. C. Miall. Flower Shows in City Schools, Alice R. Northrop. Observation Bee-Hive for the Schoolroom, Anna Botsford Comstock. Window Gardens for the Schoolroom, H. D. Hemenway. A Wild-Flower Garden, Isabella G. Diggings. Making a School Lawn, Margaret T. Brown. Time Required for Nature-Study, S. B. Sinclair. Method of Sherlock Holmes in Nature-Study, E. A. G. Lamborn. Original Observations from Elementary Schools. Guide to Periodical Literature, III, Ada Watterson.

CONTENTS OF No. 4, JULY, 1905

Nature-Study versus Agriculture, W. M. Hayes. Nature-Study and Agriculture, Anna Botsford Comstock. Nature-Study and Agriculture, F. L. Stevens. Nature-Study in School of Nova Scotia, A. H. MacKay. Teaching Facts in Nature-Study, John Dearness. Nature-Study and its Relation to English, W. M. Heiney. The Silk-Worm for Nature-Study, Alvin Davison. Protective Colors of Animals. Facts Discovered by Children, T. D. A. Cockerell. Guide to Periodical Literature, IV., Ada Watterson.

CONTENTS OF No. 5, SEPTEMBER, 1905

Relation of Geography to Nature-Study, with Complete Outline of Courses for Eight Grades, H. W. Fairbanks. Value of Knowing Names of Natural Objects, Many Writers. An Educational Bee-Hive, Edward F. Bigelow. Do Birds Eat Butterflies, T. D. A. Cockerell. School-Gardens in Philadelphia. School-Garden Notes, H. D. Hemenway. A Plea for Wild Flowers. An Appeal for the Birds. Nature-Study in New Zealand. Nature Notes.

CONTENTS OF No. 6, NOVEMBER, 1905

The Communal Life of Ants, Illustrated, Adele M. Fielde. Study of Deciduous Trees in Winter, Clarence M. Weed. The Children's School Farm in New York City, Illustrated, Fannie Griscom Parsons. Temperance Physiology Sixty-six Years Ago, M. A. Bigelow. Plants That Hide from Animals, M. A. Bigelow. Facts Discovered by Children, Marion H. Carter. Guide to Periodical Literature, Ada Watterson Yerkes.

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No. 7, JANUARY, 1906

The Evergreens, ANNA B. COMSTOCK. What to teach in Nature-Study, L. A. HATCH. Gold-Fishes in Japan, K. MITSUKURI. Definite Problems in Nature-Study, S. B. SINCLAIR. A Simple Experiment on Spontaneous Generation, F. L. STEVENS. Sunflowers for Gold-Finches, DELIA M. HALE. Science and Nature-Study Parallel, W. M. HALLOCK. Scientific Nature-Study, an Abstract, M. A. BIGELOW.

No. 8, FEBRUARY, 1906

Nature-Study and Manual Training, W. A. BALDWIN. The School-Garden at Bowesville, Canada, E. A. HOWES. Nature-Study in its Practical Bearings, J. P. STEWART. Place of Physiology in Elementary Schools, M. A. BIGELOW.

No. 9, MARCH, 1906

School Gardens, B. M. DAVIS. Nature-Study and Manual Training, M. A. BIGELOW The Sap-Current: An Experiment. Illustrated, F. L. STEVENS. Nature-Study in City Primary Schools, M. C. DICKERSON. Galls and Gall-Flies, Illustrated, V. L. KELLOGG.

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Nature-Study and High School Chemistry, ALEXANDER SMITH. Snails for Nature-Study, M. A. BIGELOW. Study of Snail in Fourth or Fifth Grades, ANNA N. BIGELOW. Gardens for City Schools, H. G. PARSONS. Colors of Butterflies and Moths, V. L. KELLOGG. Canadian Department, Edited by W. LOCHHEAD. Discussion and Correspondence: Best Books for Nature-Study. Organization of Natural History Club, H. M. BENEDICT.

No. 13, OCTOBER, 1906

School-Gardens in the Refugee Camps of San Francisco, BERTHA CHAPMAN. The Field Trip in Nature-Study, S. COULTER. Methods of Teaching Nature-Study, A. J. GROUT. The Weakness in Nature-Study, W. T. HORNADAY. Nature-Study, S. A. JOHNSON. CANADIAN DEPARTMENT, Edited by W. Lochhead: A School of Affairs, Canadian News. Crickets for Study in the Schoolroom, F. A. STEBBINS. Rearing of Roses from Cuttings, E. YODER.

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Vol. 2, No. 8
WHOLE NO. 14

November, 1906

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CONTENTS

	PAGE
Progress of Nature–Study in California. B. M. DAVIS	257
Nature-Study Work with Insects C. F. HODGE	265
Statistics from College Classes in Bird Study. E. L. RICE	271
CANADIAN DEPARTMENT. Edited by W. LOCHHEAD.	
The Foundations of Chemistry in Nature-Study. JOHN BRITTAIN	278
School-Gardens. F. W. SHATTUCK	281
The Teacher vs. a Fixed Course of Nature-Study. T. R. CROSWELL	282
Notes on Recent Pamphlets	285
Nature-Study and Science Notes	286

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THE
NATURE-STUDY REVIEW

DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

VOL. 2 NOVEMBER, 1906 No. 8

PROGRESS OF NATURE-STUDY IN CALIFORNIA

BY B. M. DAVIS

State Normal School, Chico, Cal.

In the following account of nature-study in California I shall attempt to present some of the most important facts with respect to (a) its early history, (b) its progress and tendencies, (c) its promotion through various factors and influences now at work.

Early History of Nature-Study in California

It is difficult to determine when nature-study really began to be introduced in the State. Although it is mentioned in several school-manuals as early as 1894, it was certainly given a place in some schools at a much earlier period (e. g. in Riverside County). It is of interest to note that in the early '80's entomology was a required subject for the grades. For several years Cooke's "Insects, Injurious and Beneficial," was used as a text-book in the schools. The scheme was promoted chiefly by Matthew Cooke, then head horticultural officer of California, with the idea of disseminating knowledge of insects among public-school children, and thus indirectly aiding in the preservation of crops from injurious insects. The plan never worked, for it became almost from the beginning a prefunctory text-book subject. In fact teachers paid barely enough attention to it to carry out the letter of the law. The later conservative attitude of the California teachers toward the introduction of nature-study may have been, in part, due to this early experience with entomology.

At the annual meeting of the State Teachers' Association of 1896 nature-study was vigorously discussed. Two committees were appointed to report at the next annual meeting; one on "the state of

nature-study in Northern and Southern California," the other on "a natural history survey of California." These reports were presented at the meeting of 1897.[1] The following summary of the first report will indicate the progress of the subject up to 1897.

"In the courses of study now enforced by the school authorities there is already a place given to nature-study, but the work outlined is not satisfactory as yet in either matter or method."

"Among the teachers there is a wide-spread belief that nature-study is a necessity. In addition a relatively large number are doing work, good so far as individual lessons are concerned, but at irregular intervals and without definite plan."

"In a few cities the work has been done on such a scale and in such a way as to afford a basis for the coming year."

"The teacher's preparation need not be more than the present four years course at our State Normal Schools or its equivalent—a high school course plus professional training—and less than this should not be accepted as sufficient preparation for any teacher."

The second report will indicate something of the ideal of the work as held by prominent leaders in the movement. It is, in part, as follows:

"To catalogue the literature of the natural history of California, with special attention to the literature of the distribution and life-history of such animals and plants whose use in nature-study seems to be specially feasible and advantageous, as for instance, a complete bibliography of Odonata (dragon-flies) of California, a list and description of all the species of dragon-flies known to belong to California with synopsis and key for identification of species, and an account of the natural history and methods of rearing dragon-flies."

"To conduct a natural history survey with the special object of determining the distribution and life-history of those animals and plants which seem to be specially available and important for use in nature-study in the schools. (Dragon-flies to be taken up first). To arrange and publish the results of the survey work so as to make these results available for use of teachers."

Professor Vernon Kellogg who made this report also presented concrete examples (subject dragon-flies) "as illustrative of the various aspects of the undertaking."

The same idea of a natural history survey was presented by Professor O. P. Jenkins at the 1897 meeting of the Southern California Teachers' Association.

Although Professor Kellogg prepared an account of the Odonata of California with key for determining species and a brief description of each species, for some reason no attempt was made to publish it. Here the Association missed an opportunity. But however good its

[1] Proceedings of the California Teachers, Association for 1897. pp. 195–198.

intentions, its organization does not admit of the prosecution of work of this character. One of the promising things for the future educational interests of California is the contemplated reorganization of the Association which will make such work possible.

As has already been said, the report just quoted reflects something of the ideal held by those who were leaders in the movement. It is quite certain that at this time the idea of nature-study carried with it very generally the idea of elementary science. The child had not been taken very seriously into consideration.

The suggestion of a natural-history survey is a good one and deserves a better fate than it then met. If the children and teachers of the public schools could be led to participate in some such work, and if at the same time this work were well organized and directed by those who would keep the child's point of view in mind rather than that of the scientist, such an undertaking ought to succeed. Indeed such a scheme is not without precedent; its practicability has already been demonstrated by the phenological observations conducted in the public schools of Nova Scotia under the direction of the Botanical Club of Canada.[2] "These observations are especially valuable as furnishing a stimulus for a portion of nature-study work in the public schools of the Province. It is, no doubt, starting many young pupils on the beginning of an observant course which will make them specially useful citizens; while it substitutes an enjoyable occupation for otherwise monotonous hours spent on the road to and from school. The work has also some scientific value, worthy of preservation and compilation of observations."[3]

Progress and Tendencies of Nature-Study in California

The progress and general trend of nature-study in the State since 1897 is well shown in an examination of the county courses of study recently made by Professor Everett Shepardson.[4] Referring to the prominent movements in California education he says that the manuals, circulars, courses of study, etc., show what the county boards of education thought should be done and so, in a measure, represent the

[2] [A leaflet concerning this work may be obtained from Dr. A. H. MacKay, Superintendent of Education, Halifax, N. S.]

[3] *Journal of Education*, Halifax, Nova Scotia, Apr. 1905, p. 72.

[4] A Comparative Study of the Courses of Study of Forty six Counties from about 1896–7 to 1904, by Everett Shepardson. *Western Journal of Education*, vol. XI, (1906) No. 8, pp. 9–17.

ideals of the county boards of these forty-six counties. He regards the change of ideals towards nature-study as especially noteworthy, and sums it up as follows:

"In both the earlier and later periods observation lessons and nature-study begin usually in the first grade. This study now usually extends two or three years longer than it did about ten years ago. What is of more significance is the attitude toward the work. The study as elementary science was at the earlier period emphasized by twenty-four counties, while only nine at the later date so emphasized it. On the other hand only five at the earlier date emphasized the love and appreciation of nature, while sixteen emphasized this in 1904–5. This seems to me a very praiseworthy change. That the county boards should have assisted the children to come into their literary inheritance is to their credit; that a few of them should have become more helpful in leading children to appreciate nature is to the credit of those few and the movement is surely in the right direction. The work of such leaders as Professor Hodge of Clark University and Professor Bailey of Cornell University has not been entirely vain in our own state. . . . . In the same connection is to be noted a marked tendency to study the physical and chemical forces, and plant, animal and mineral forms as constituents of one great organic whole and not as separate objects. The practical phase of one portion of this field has been emphasized. No county in 1896 mentioned agriculture in its manual. It appeared as a prescribed study in some form in twelve manuals in 1904-5. . . . In regard to school-gardens, California is far behind some of the Eastern states and European countries." (The manuals of five counties make mention of school-gardens, and one definitely mentions forestry.)

As just stated, agriculture was not mentioned in manuals of 1896 whereas in 1904–5 it appears as a prescribed study in twelve manuals. Early in 1906 the writer addressed letters of inquiry to all the county superintendents of the State for the purpose of determining to what extent attention was being given to agriculture (i. e. certain phases adapted to elementary schools), and also the general attitude of these teachers toward the introduction of this subject.[5] Out of thirty-seven counties sixteen reported as giving such instruction, twelve as doing a little along the line of agriculture and three as giving no attention to it, while all but three expressed an opinion that some such work is desirable in country and village schools. Thus it may be seen that the movement to emphasize the agricultural side of nature-study is making rapid gains. The interest in this movement is further shown by the fact that the leaders in agricultural matters are actively lending

[5] Shall Teachers be Prepared to Give Instruction in Elementary Agriculture? B. M. Davis *Western Journal of Education*, vol XI, no. 5, pp. 5–15. This report was submitted to the Joint Board of the California State Normal School Trustees at its annual meeting held at Chico, Cal., April 13, 1906.

their support. Probably the most important sessions of the last meeting of the State Teachers' Association, the greatest meeting in the Association's history, were the ones in joint session with the State Farmer's Institute. Already similar sessions are being planned for the next meeting of the Association, and also for the next meeting of the Northern California Teachers' Association.

It must not be inferred from this that nature-study in California is running entirely into agricultural lines, but rather that certain agricultural subjects represent a practical center around which to group much if not most of the nature-study.

Another line of activity should be mentioned in this connection. I refer to the nature-study conferences held under the auspices of the Department of Education of the University of California. Gathered at these conferences were representative men and women from various parts of the State who were interested in nature-study, and who took part in the discussions.

The first conference was held at Berkeley, Feb. 13, 1904. The discussion centered around the following questions:

1. What common purposes, if any, should appear in nature-study in all schools in which it is pursued? Does the purpose change from grade to grade?

2. How is nature-study related to other subjects pursued in the same grade? Is it an advantage to have it closely connected with school-gardening or with some other form of manual training?

3. Is a central bureau of information needed to distribute literature and carry on correspondence directed to the furthering of nature-study, on agricultural or other industrial lines? How may the teachers of the State be otherwised helped in carrying on such instruction?

In November of the same year another conference was held. This meeting was devoted to the consideration of (a) agriculture in the public schools, and (b) proposed resolutions "relating to the encouragement of such studies through legislative provision for a Central Bureau of Information, for special training of teachers and supervisors, and and for the appointment of supervisors to act as deputy county superintendents of schools."

The latter meeting resulted in the matter being presented to the legislature in the form of a bill embodying essentially the above resolution. Although the bill did not become a law, it attracted a great deal of attention throughout the State and the emphasis placed upon nature-study, especially along the lines of elementary agriculture gave a great stimulus to the subject everywhere.

Factors and Influences now Contributing to the Progress of Nature-Study in California

Much of the pioneer work in nature-study in the State emanated from Stanford University, the chief worker being Professor O. P. Jenkins. Professor Jenkins has always been and is yet very active in the promotion of nature-study, not only at the University where he conducts courses in the subject for teachers, but also among the teachers of the State.

The University of California, especially since 1900, has shown a great deal of interest in nature-study. Allusion has already been made to the conferences directed by the Department of Education. The originator and leader of these conferences was Professor Elmer E. Brown, now U. S. Commissioner of Education. The College of Agriculture and Departments of Botany and Zoölogy have lent their hearty coöperation not only by assisting in these conferences but also in giving courses in nature-study to teachers and prospective teachers. Special provision has been made for the subject in each of the summer sessions, courses being given in nature-study, elementary agriculture, and study of insects.

Mrs. Anna Botsford Comstock of Cornell University has conducted courses in nature-study in both universities.

When we consider that over forty per cent. of the teachers of the State have received their training in normal schools and that the number of such trained teachers is rapidly increasing (the demand being now greater than the supply), it will be seen what an important factor these schools are in the elementary education of California. Much attention is given in all of these schools to various phases of nature-study. Four out of the five State Normal Schools have school-gardens in connection with their training schools. At the last annual meeting of the Board of State Normal School Trustees especial attention was given to the question of preparing teachers to give instruction in elementary agriculture. The importance of such preparation of teachers is emphasized by the fact that over eighty per cent. of the graduates of these schools have their first experience in rural schools or village schools in rural communities. All the State Normal Schools, with the possible exception of the one located at San Francisco, are beginning to give greater attention to work in nature-study involving agriculture.

On May of the present year the *Audubon Society of California* was organized. Already its influence is being felt in the public schools.

Eight junior societies have been organized, and by means of its publications many more schools not represented by junior societies are being reached. Much credit is due Mr. W. Scott Way, secretary of the State Society, for his untiring energy and devotion to cause of bringing about as he says "a better understanding between man and his friends, the birds." To this end he has planned to put the Society's educational literature into every school in California.

Especial reference should be made to the work in nature-study in the public schools of Los Angeles and Oakland. In the former city Mr. George Leslie has instituted an unique organization which includes not only the work of nature-study in the grades but science in the high schools as well. Space does not permit of more than a passing mention of this work, but I may add that not the least important feature is the work of the high-school science teachers in helping the teachers of the grades.

In the latter city Miss Bertha Chapman has given a splendid object lesson in the use of school-gardens as a working center around which to group most of the nature-study activities of the schools.

Many other individual workers deserve mention for the contributions which they are making to the progress of nature-study in the State, but lack of space forbids.

Various publications bearing on different aspects of nature-study have appeared from time to time. The following annotated list, arranged in chronological order, although not complete, will indicate something of the character and scope of this literature:

"A Popular California Flora:" Volney Rattan. San Francisco, Bancroft Co., first ed. 1879, eighth ed. 1891, pp. 252. This is a manual of botany for beginners with illustrative introductory lessons especially adapted to the Pacific Coast. The fact that this book has passed into its eighth edition is sufficient comment upon its popularity. For a long time it was the only manual of the California flora within reach of the average teacher. Many teachers who were interested in California wild flowers have used it with their pupils. It has undoubtedly been of great service in spreading a knowledge of our common native plants.

"Insects, Injurious and Beneficial:" Matthew Cooke. San Francisco, Bancroft Co., 1883, pp. 171. Reference has already been made to this book. It was designed as "an elementary text-book for use of schools." It is well illustrated and contains a good deal of natural history as well as classification. As a book of reference it has been very useful, although the experiment of making the teaching of entomology mandatory in the public schools failed.

"Exercises in Botany:" Volney Rattan. San Francisco, Whitaker and Ray

Co., 1897, pp. 120. These exercises, numbering fifty-seven, deal with plant-structure and growth, beginning with the seed and completing the cycle to the seed again. The book is intended to be used in the elementary schools, and requires no other equipment than that furnished by the average country school. Illustrative material is taken from the Pacific Coast flora.

"California Plants in their Homes:" Alice Merritt Davidson. Part I: A Botanical Reader for Children; part II: A Supplement for Teachers. Los Angeles, B. R. Baumgart, 1898, pp. 349. This book is arranged according to the California seasons, and is intended for use in the public schools. It has been used extensively in southern California.

"Lessons in Nature-Study:" Oliver P. Jenkins and Vernon Kellogg. San Francisco, Whitaker and Ray Co., 1900, pp. 191. These lessons were put in manuscript form for the use of the Oakland schools. In answer to a wider demand they were revised, extended and illustrated and in this new form published from time to time during 1898–9 in the *Western Journal of Education*. Finally in 1900 the lessons were again revised and published in book form with the above title. The lessons, thirty-seven in number, cover a wide range of subjects including chemical and physical phenomena, animals, particularly insects and plants of various kinds.

"Nature-study Bulletins: Butterflies," C. W. Woodworth; The Living Plant, W. J. V. Osterhout, Berkeley, Cal. The University of California Press, 1900, pp. 64. These two bulletins were issued in one pamphlet. The first on butterflies gives methods of study and list, illustrated by text-figures and plates, of three hundred and fifty-four species known to occur in California. The second deals with the life-processes of the plant worked out by means of easily performed experiments.

"Stories of Our Western Birds:" Elizabeth and Joseph Grinnell. San Francisco, Whitaker and Ray Co., 1903, pp. 203. This popular little book contains accounts of many of our common California birds based on the observations of the authors. Besides these accounts it contains descriptions for identification of forty-two species.

"School Gardens for California Schools:" B. M. Davis. Bulletin No. 1 Chico, California, State Normal School, 1905, pp. 79. This is a manual for teachers and is intended to give all the necessary information for conducting school-gardens. Local conditions were considered in the preparation of an annotated list of the most common and important insects of California, with references to literature, and a plant calendar including list of vegetables and flowers suitable for school-gardens with time of planting, direction, etc. It also contains a bibliography of school-gardens of over two-hundred titles, and an appendix of exercises for study of soils and other factors in plant growth.

"Humane Education:" W. F. Bliss, et al. Bulletin, San Diego, Cal. State Normal School, 1906, pp. 30. This bulletin deals with nature-study but from the

point of view of a sympathetic appreciation of animals. It was prepared "for the purpose of aiding teachers in carrying out the provisions of a recent amendment to Section 1665 of the Political Code of Califorina, prescribing instruction in humane education."

It will be seen from the foregoing discussion that nature-study in California has developed from something more or less indefinite, and practiced at irregular periods in a few schools, to a subject of considerable importance with a tolerably definite place in the school system of the state. The forces now at work are making it more definite in the minds of the teachers and useful as a school subject. As the problem of subject-matter and method is now being studied as never before, from many points of view the outlook for the future is very hopeful.

NATURE-STUDY WORK WITH INSECTS

By C F. HODGE and photographs by O. P. DELLINGER

Clark University, Worcester, Mass.

No teacher who has not given the matter a fair trial can realize the almost boundless resources which our common insect life affords for lessons of practical interest and value. Some years ago, in revising the course for science lessons in the Worcester schools, a few common insects were assigned to each grade for study during the year. In the old course, as is commonly the case, the common flowering plants and trees were well covered, and the revision was ordered largely with a view of including the animal side of nature-study. The following case may be cited to give the general reaction of the teachers to the innovation:

One of the principals, Mr. L—, at the first meeting with his teachers in the fall, called attention to the changes in the science course and said in effect: "The people request us, as indicated by the printed course of study with which we are provided, to give instruction about the common insects of the city. The request is reasonable, and while we may not be able the first year to take up all the insects suggested for study under each grade, I shall expect each teacher in the building to make a beginning this fall. If we will not or cannot do it, the people will find someone who can."

One of the teachers on leaving the room said, "Bugs! Bugs! Oh Mr. L—, you really don't mean that we are expected to give lessons on bugs." When assured that that was exactly what was intended, she replied, "Oh dear, I wish you were not such a good friend of Dr. Hodge."

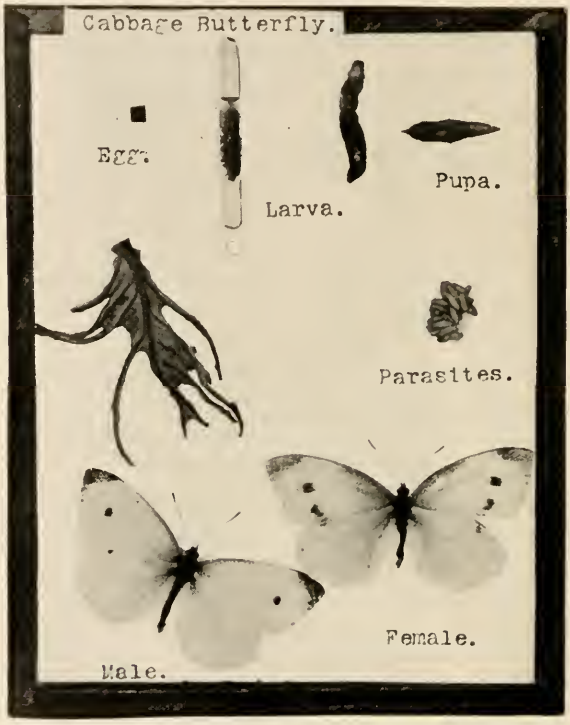

FIG. 1.—Life-history of the cabbage-butterfly. Mounted in case described in text of accompanying article.

This reaction is typical and natural enough, but during the following week the principal noticed in visiting the teacher's room that each pupil had a little box—cigar or pasteboard, some of them with glass covers—in which cabbage-caterpillars were feeding on fresh cabbage leaves. The work was begun and the teacher seemed to be pleased with it. A week or two later, on visiting the room again, the same teacher met him with, "Mr. L.—why haven't we been doing this work before? It is the finest nature-study I have ever tried. The children are wild over it. They have worked out the whole story of the

cabbage-butterfly's life, seen the white butterfly lay its eggs on the leaves, watched the caterpillar feed and grow, seen it spin and change into a chrysalis and seen the butterfly burst out of its queer shell. I begin to see the possibilities of insect nature-study. We have never had anything that compares with this."

From another school the teacher relates the following incident in point: She observed one of her boys looking intently into his box; his eyes began to bulge out; his mouth fell open; without relaxing his intent gaze, his hand went up and he exclaimed, "Teacher something is happening to my worm." Class and teacher gathered around the desk and saw the ichneumon parasites bore their way out of the caterpillar and spin their cocoons on its back, thus getting a glimpse into the role which beneficial insects play in the economy of nature.

In addition to magic transformations, exquisite beauty and other inherent interests, the work of insects in relation to man gives the subject a solid practical basis which appeals to all alike. The annual tax imposed by insects upon the agricultural interests of the country is now estimated to be not less than $795,100,000. Who pays this tax? Some are inclined to say: "These matters belong to purely agricultural education." But who pays the tax? Everybody pays it. It is a part of the cost of every pound of meat or flour or hay, every yard of cotton or woolen or linen cloth, every parcel of fruit or foot of lumber. The tax may fall in part on the producers, but in the main and in last analysis the consumers must bear the brunt of it. If insects destroy half the crop, the argument is, the farmers get double the price and have less work; hence insects are a benefit to the farmers. The insect tax is imposed on the whole people as a natural consequence and direct result of ignorance; and the insect problem is no less the problem of the whole people, every citizen having his part to bear in its solution. Until we realize this and teach accordingly, we shall always have ignorant people who breed insect pests to damage their neighbors, or who wantonly destroy birds and other insect eating animals, either directly or indirectly, by keeping inconsequent and uncontrolled cats which destroy (Forbush) an average of fifty song birds a year.

In the case of insects, more than in any other branch of nature-study, a teacher needs actual specimens Insects are so small, there are so many different kinds and so many of them look alike to beginners that no amount of description and no possible illustration

can take the place of the specimen. With it a teacher can say: "Here, children, are the eggs of the white-marked tussock moth just as they were laid on the bark of an elm tree. There are several hundred eggs in the mass and each may hatch into a caterpillar, like this one you see in the case. If we are not careful, they may become so numerous as to strip the leaves off from our orchard and shade trees. Let us see who can bring to school the greatest number of them before they hatch this spring." The same may be done with a hundred or

FIG. 2.—Insect nature-study in the schoolroom. Grade IV, Downing St. School, Worcester, Mass., Miss Edna R. Thayer, teacher. To the left is a large screen-wire breeding cage for living insects. On the left-hand corner of the table is a 4 by 5 insect mounting case arranged for an ants' nest. The rest of the picture shows the insect mounting strips, with Miss Thayer bending one into form, other materials and unfinished and finished mounts.

more common insects, if we have the specimens to start them off with.

What sort of collections, then, shall we have for our nature-study work? Too often we have seen nice little collections pinned out in cigar boxes in the spring reduced to dust by dermestes by the time school opened in the fall. This is discouraging to pupil and teacher alike. Plaster Paris moulds, such as are used in show-museums, are too expensive and are not suited to elementary instruction because they do not permit seeing both sides of the specimen. Further, they are usually made for single insects and do not lend themselves to life-history collections. Children require the life-story side and, hence, this is a fatal defect in the method and unfits it for purposes of elementary instruction.

Standard insect cases are too large and cumbersome, besides being too expensive for common school use. I have found a number of teachers, too, who objected to showing children insects with pins sticking through them. Teaching experience also proves that if we have more than one kind of insect before the class at the same time, great distraction and confusion is apt to result.

All the requirements of a serviceable school collection are met by the simple insect mounting case described in Chapter IV of my book, "Nature-Study and Life." I do not need to repeat the description there given. However, one improvement in the method has been so widely adopted and has given rise to so much inquiry that I am glad of the opportunity to place a description of it on record. I refer to the "insect mounting strips," first made according to my specifications by the A. I. Root Co., of Medina, Ohio, in 1902. The device has since become a recognized piece of nature-study apparatus and is kept in stock and sold by this firm, although, I suppose, any manufacturer of bee-keepers supplies could fill an order on short notice. The cases have been used successfully for ants' nests, and I have had clothes moths live in them with woolen cloth of different colors to feed upon for nearly two years sealed up tight with the passe-partout. In a word the method consists in mounting the insects between two plates of glass with strips of thin wood glued around the edges of one of the glass plates to keep the glasses the proper distance apart. To plane out and fit the four little strips was more trouble than all the rest of the work of making the mount. It was only when confronted by a class of 140 in laboratory nature-study at the Indiana University Summer School—when I had expected not more than 10—that necessity became the mother of invention and hit upon a more expeditious method. This consisted in having the wood strips made in a single piece, like the common honey section, cut so as to bend into a rectangular frame of the desired size. My first order was for 9,000 "Insect Mounting Strips." It was given Friday morning and we had them for use in the laboratory in Bloomington the following Tuesday. The bill was $12.50—approximately ten frames for one cent, less for the smaller sizes and a little more for the larger.

The sizes were made for convenience in handling and at the same time to utilize waste negatives of four by five and five by seven inches; the strips being cut in three widths, one-quarter, three-eighths and one-half inch, to fit specimen insects of different thicknesses. For small insects the size two by five inches was adopted, because this could be covered by cutting a four by five glass in two.

The ends of the strips are dovetailed so as to lock together smoothly, when bent into a rectangle, and thus the making of the frame is reduced to a matter of a second or two. The material is white basswood very smoothly finished and looks well as it is. Most people, however, prefer to have the inside surface blackened so as to be less conspicuous in the finished mount. This is done by laying a lot of the strips on a sheet of newspaper and brushing over the inside surfaces with a flat brush and common writing ink. The frame is glued to one of the glass plates, preferably with a flexible glue, the insects arranged as desired and glued to the glass, the other glass put on and the whole bound with a strip of black passe-partout. The specimens should be fastened to the glass in the order of natural sequence or development so as to read like the words in a line, viz., eggs, larvæ of different sizes, pupæ, male and female, if distinguishable, and male and female adult, and then add such bits of work of the species—gnawed leaves, galls, borer channels, etc.,—as there may be room for in the case. They will thus tell to the child the story of the life and work of the insect, at a glance and in the characters of nature itself.

The material used to fasten the insects to the glass has given some trouble. I advised in my book that to prevent the glue from becoming brittle and scaling off from the glass there should be added 20 drops of glycerine to the ounce of ordinary liquid glue. I have not found this to work badly myself, but the complaints that have been sent me from humid localities are convincing that this is not a safe method. The glycerine is hygroscopic and may take up water enough from moist air to cause the glue to liquify. Canada balsam makes a good adhesive, but that is hardly available for the ordinary school. Of late years I have added to very thick liquid glue about one fifth its bulk of honey—after experimenting with different proportions—and have found this to work well. For the present this is the best material for the purpose I am able to suggest. I am now experimenting with the "flexible glue" used by book-binders, and find that it is likely to serve the purpose, but it requires more time to make a thorough test.

The problem of putting insect nature-study on a footing at once reasonable and befitting its importance to the varied interests of the country as a whole is a large one. The writer hopes that a number of teachers may give to readers of THE REVIEW the benefit of their experience with this line of work.

STATISTICS FROM COLLEGE CLASSES IN BIRD STUDY

BY EDWARD L. RICE

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In the spring term of 1902 a course in bird study was introduced as an elective in the curriculum of Ohio Wesleyan University, Delaware, Ohio. It seemed a matter of some interest to determine approximately the amount of knowledge (or ignorance) of our common birds possessed by the average student; and data were collected in the years 1902, 1903, and 1904, upon which the following tabulations are based. The results have been reported before the Ohio State Academy of Science and also before the zoölogical section of the American Association for the Advancement of Science, but have not been published.

Data were secured from 126 students, 55 men and 71 women. These students were drawn from all courses and all classes, a few preparatory students being included. The great majority had had no previous collegiate work in biological science, although a few were somewhat advanced scientific students. In a word, they were average college men and women.

Mimeographed copies of the list of 75 species of birds shown in Table 1 were distributed at the beginning of the course, and the students were directed to mark the names of those birds with which they were acquainted. For the sake of comparison similar records were collected at the close of the course. Some explanation was given at the beginning of the course to eliminate so far as possible the difficulty arising from the multiplicity of popular names and from the misinterpretation of familiarity with a name for real acquaintance with the bird. But, in spite of these precautions, error could not be wholly avoided; and the personal equation of the students furnishing the data introduces another element of uncertainty, so that the results can be considered only as an approximation to the real conditions. Certain cases of palpable error will be commented upon in following paragraphs.

In 1902 the comparatively recently awakened interest in nature-study in the secondary schools had hardly begun to make its influence felt in the colleges of Ohio. But the rapid spread of nature-study in

the lower schools cannot fail to lead to a rapid advance in nature knowledge on the part of college students in the immediate future. In fact recent imperfect data, not included in these tabulations, seem to indicate an already perceptible beginning of this advance.

No reference will be made in the following paragraphs to any phase of bird study other than identification. This is not due to an overestimate of the value of identification, which, like the alphabet or the multiplication table, should be but a means to an end; rather it is due to the fact that the work of identification, unlike other phases of bird study, gives a basis for at least an approximate quantitative measurement of the student's knowledge, and so adapts itself admirably to the purposes of the present study.

The data collected should afford an answer to each of the following questions:

1. How many students know each bird?
2. How many birds does each student know?

The first of these questions is considered in Table 1. Here the birds are arranged in the order of their familiarity at the beginning of the course; and the numbers in the first column, headed "Before," indicate the number of students claiming acquaintance with each species. The third column, headed "After," indicates correspondingly the number claiming such acquaintance at the end of the course.

It will be no surprise to find the robin at the head of the list, familiar to all the students but one, who was a new arrival from the southwest and, apparently, from a region where the robin is locally rare, if found at all. On the other hand it was a distinct shock to the writer's country-bred mind to find that any man or woman could fail to know such birds as the crow, the bluejay, and the bluebird; and the number unfamiliar with these species is too great to be explained on geographical or accidental grounds.

Another interesting point is brought out by the figures of the second column, entitled "Error." These indicate the number of students claiming to know the respective species at the beginning of the course, but recognizing their ignorance after three months of study. In the case of the screech owl and turkey buzzard the number of students claiming knowledge at the close of the course is actually smaller than at the beginning. This is a point on which the instructor prides himself, for there is no knowledge harder to impress on a student than the knowledge of his own ignorance. The explanation of the very large error in these two cases and certain others

TABLE I.

	Before	Error	After		Before	Error	After
Robin	125		126	Red-tailed Hawk	15	1	64
Bob-white	121	1	122	Yellow-billed Cuckoo	13		99
Crow	119		126	Bank Swallow	13	1	63
Hummingbird	114	1	124	Cedar Waxwing	10		106
Blue Jay	112		126	Towhee	10	1	100
Red-headed Woodpecker	111		126	Tufted Tit	10		98
Bluebird	111	3	120	Spotted Sandpiper	9	3	99
Mourning Dove	109	1	122	Hairy Woodpecker	9	2	69
Cardinal	109	6	119	Scarlet Tanager	8		123
Screech Owl	103	23	90	Tree Sparrow	8	6	40
Turkey Buzzard	82	14	81	White-breasted Nuthatch	7		81
Barn Swallow	75	8	85	Horned Lark	7	2	26
Catbird	73		123	White-throated Sparrow	6	2	75
Meadow Lark	71		119	Vesper Sparrow	6	1	56
Goldfinch	68	8	103	Wood Thrush	6	1	51
Red-winged Blackbird	67		124	Hermit Thrush	6		48
Killdeer	67	5	90	Orchard Oriole	6	1	41
Chimney Swift	66	1	111	Crested Flycatcher	5		109
Bronzed Grackle	53	7	106	Brown Creeper	5	2	34
Baltimore Oriole	51		123	Rose-breasted Grosbeak	3		102
Flicker	49		123	Golden-crowned Kinglet	3		83
Junco	47	15	77	Fox Sparrow	3		60
Chipping Sparrow	45	9	71	Black and White Warbler	3		59
Sparrow Hawk	43	6	89	White-crowned Sparrow	3		52
Kingfisher	40		117	Oven-bird	3	2	24
Wilson's Snipe	40	21	56	Ruby-crowned Kinglet	2		85
House Wren	39	4	75	Black-billed Cuckoo	2		66
Brown Thrasher	34		123	Redstart	1		61
Song Sparrow	34	5	93	Yellow-breasted Chat	1		60
American Woodcock	33	4	83	Red-eyed Vireo	1		50
Kingbird	27	2	81	Maryland Yellow-throat	1		38
Bobolink	25	3	88	Lark Finch	1		21
Downy Woodpecker	24	1	96	Red-breasted Nuthatch	1		13
Field Sparrow	21	3	85				
Phoebe	21	6	71				
Cowbird	20	1	104				
Purple Martin	20	1	76				
Wood Pewee	20	6	63				
Indigo Bunting	19		97				
Yellow Warbler	19	3	96				
Nighthawk	16		67				
Chickadee	16	6	36				

Number of students knowing each species of bird. Data recorded for 126 students. Explanation in text, page 272.

(e. g. Wilson's snipe) is probably to be found in the extreme familiarity of the names, and a mistaking of knowledge of name for knowledge of the bird itself.

The third column requires but a single comment. This does not show so accurately as the first column the commonness and conspicuousness of the birds in the field, for a part of the course was devoted to laboratory identification of stuffed specimens. Thus, for example, the rose-breasted grosbeak is far from common in the near neighborhood of Delaware; but the plumage of the male is of such a character as to impress the laboratory specimen upon the attention of almost every member of the class. Only three students were familiar with this bird at the beginning of the course 102 at the end. The conditions are similar in the case of the scarlet tanager and the cedar waxwing, although both are locally much commoner than the grosbeak.

In Table 2 the data are considered from the other point of view, the number of birds known by each student. The tabulation is largely self-explanatory and there is need of little comment beyond the emphasizing of a few interesting points. The data for the men and women are first plotted separately (I and II) and then combined in a curve for the entire class (III). In each case abscissas [horizontal] indicate numbers of birds known; ordinates [vertical] percentages of men, women, or entire class respectively. The solid lines represent the conditions at the beginning of the course, the broken lines at the close.

The curves for the beginning of the course are the more important and will be first considered. Because of their more active out-door life, the men would naturally have a more extensive knowledge of the birds than would the women; and this is clearly shown by a comparison of the curves I and II. While the apex of the curve for men shows a maximum number (24 per cent.) knowing from 31 to 35 species, the corresponding apex for the women (representing 31 per cent.) falls in the column indicating a knowledge of only 11 to 15 species.

In curve III for the entire class the double maximum is easily explained from the co-educational character of the class, the one maximum being determined by the men, the other by the women. But a very curious fact comes to light in that the separate curves for men and women (I and II) both show somewhat similar, though less striking, double maxima. The curves are based on somewhat scanty data, and the secondary maxima may be merely accidental; but another

TABLE 2

Graphic representation of number of species of birds known by individual students. Data refer only to species of birds listed in Table 1. Data recorded for (I) 55 men; (II) 71 women; (III) 126 men and women. Further explanation in text, page 274.

explanation is more probable. It is significant in this connection that the secondary maximum for the men falls to the left of the primary maximum, thus indicating a less degree of knowledge, while for the women the conditions are reversed, the primary maximum falling in the column of less and the secondary maximum in that of greater knowledge. The interpretation is tentatively advanced that these double maxima indicate the existence among both men and women of two somewhat distinct groups,—an "out-door" group and an "in-door" group, the first large in the case of men, the second in the case of women. It is tempting to correlate these groups with country and city life; but the proportion of city and country students is presumably about the same for the two sexes. More likely the distinction is one of temperament and taste, the large "out-door" group of men resulting from the generally more active life of men, already noted as reflected in Table 1. In exaggerated statement, the secondary maxima may be said to be determined respectively by the "tom-boys" and the "sissies."

The isolated fragment of solid line at the extreme right (I and III) represents a single student,—a farm boy, self-trained in accurate observation of nature, and later an excellent assistant in the work of the course.

The curves for the close of the course (broken lines) are less regular; but again the curve for the whole class (III) shows clearly its composite nature, the two well marked apices corresponding respectively to the maxima for men and women (I and II).

A comparison of the broken with the solid lines in Table 2 gives a fair impression of the gain in knowledge during the course; but this is more strikingly brought out by the figures of Table 3. From these it may be seen that the average number of birds known has increased 107 per cent. for the men, 165 per cent. for the women, and 138 per cent. for the entire class. It is fair to add, also, that the knowledge claimed at the close of the course is subject to much less discount for error than that at the beginning.

TABLE 3

	Men and Women	Men	Women
Minimum at beginning of course	4	10	4
Minimum at close of course	22	25	22
Maximum at beginning of course	75	75	40
Maximum at close of course	75	75	70
Average at beginning of course	21	27	17
Average at close of course	50	56	45

Number of species of birds known by individual students. Data refer only to species listed in Table I.

From Table 3 one also obtains a striking impression of the popular ignorance of our common birds. It is hard to believe that a group of college students should, on the average, know only 21 species; it is almost impossible to believe that even a single student should know but four species. Yet the student knowing but four species was closely followed by another reporting but five, while fifteen (about 12 per cent. of the entire number) were acquainted with 10 birds or less.

In conclusion, two familiar, perhaps trite, propositions may be urged again on the strength of the evidence cited in the foregoing paragraphs. Both are applicable to all branches of nature-study, and emphasize alike the need for this line of work and its promise.

1. Unless their attention is definitely directed toward the common phenomena of nature, very many persons will go through life without a sight or a suspicion of the fascinating interest and beauty with which they are surrounded.

2. Even a short course in a single line of nature-study may awaken the attention of such persons so that, having received the key, they may translate nature's cipher, and may come more and more to see and to hear and to understand.

CANADIAN DEPARTMENT

EDITED BY PROFESSOR W. LOCHHEAD

Macdonald College, Ste. Anne de Bellevue, Quebec

Our Canadian readers will no doubt be pleased to know that Dr. John Brittain, of the University of New Brunswick, Fredericton, N. B., one of the best and most enthusiastic teachers of nature-study in Canada, will contribute a series of articles on "The Foundations of Chemistry in Nature-Study" during the coming year. His first article "Chemical Union" appears in this number.

V. W. Jackson, B.A., Demonstrator in Biology at the Ontario Agricultural College, Guelph, for the past two years, has been appointed Instructor in Nature-Study for the district of Auckland, New Zealand, and has already entered upon his duties. He will have general charge of the nature-study work, including school-gardens, and will assist the teachers by lectures, conferences and visits to their schools. Much attention will be given to the agricultural phase of nature-study.

THE FOUNDATIONS OF CHEMISTRY IN NATURE-STUDY

I. Chemical Union

At the basis of all the natural forms we see—organic and inorganic—lies the fact of chemical union or combination. To learn to distinguish it, by its effects, from mere mechanical mixture, it is not necessary for the learners to wait until they have become acquainted with the molecular and atomic theories. Only very simple apparatus and cheap material are required for the experiments which follow.

Each member of the class is supplied with a small stick of *dry* white wood. The sticks are held for a few seconds in the flame of a spirit lamp. At once a soft black substance appears in the heated part of the stick—a substance which will mark on paper and which will be found to be insoluble in water. The pupils recognize this as charcoal which they may be told is a form of carbon. Now the question is, where was the charcoal before the stick was heated? We could not see it before that was done.

It will be found, by holding the hand above the flame of the lamp, that no charcoal issues from *it*—nor does it come out of the surrounding air. Hence it must have been in the stick at first. But why did the charcoal not then make the stick black?

Heat slowly and carefully a little dried wood, cut into small pieces in the bottom of a closed test-tube. Clear drops of a tasteless liquid like water form on the inside of the tube above the wood; and as the water gathers, the charcoal appears. The water evidently comes out of the dry wood and leaves the charcoal behind.

It can easily be shown, by means of a hand balance, that a piece of charcoal (from a stove) weighs less than a piece of the dry wood, equal in size, from which the charcoal was obtained.

It is plain then that *dry* white wood contains both charcoal and water, and that when the water is driven out by the heat, the charcoal can be seen. And so it appears that the water in the wood hides the charcoal, else the wood would look black, and the charcoal conceals the water, else the wood would feel wet.

It may now be stated that when two substances—as charcoal and water in this case—are so united together that they conceal each other's properties, the two substances are said to be chemically united or combined; and the substance they form by their union is called a chemical compound. Thus dry wood may be regarded as a chemical compound of carbon and water.

Next mix together, in a bottle, water and powdered charcoal. Do they unite chemically? They do not conceal each other's properties. The black charcoal can still be *seen* and the water *felt*. They now form, not a chemical compound, but a mechanical or physical mixture. But how can the charcoal and water be got to unite chemically? They must have been chemically separate before they united to form wood; but *we* don't know, at present, how to compel them to combine to form wood.

Put finely divided wood, to the depth of about an inch, into a test-tube loosely closed with a cork or the thumb—and apply heat until the tube is filled with smoky gas; then without withdrawing the heat remove the cork or thumb, and try with a match until you succeed, to set fire to the gas in the tube. How do you account for this combustible "wood-gas"? Since this gas will burn, it cannot be water-gas (steam); so we must conclude, since chemists find that pure wood is composed entirely of carbon and water, that this gas was formed in some way from these two substances in the wood. It should be noted

here that the water set free by the heat soon becomes colored by some other liquid, and that a mass of charcoal remains in the tube after the water and the combustible gas have been all expelled. It will be found upon trial that this charcoal residue, although it will not burn with a flame like the gas, will slowly burn away with a *glow* when held by a wire in the flame of the lamp.

It seems from this experiment that when wood is heated in a closed space, it breaks up into other substances besides charcoal and water. This will explain too, in part, the manufacture of charcoal and wood alcohol by the destructive distillation of wood, that is by heating wood in closed vessels, and the production of coke (carbon) and coal gas from bituminous coal by heating it in closed vessels.

Let the children char small samples of starch and sugar—try whether they contain water—and whether combustible gases are formed when they are decomposed by heat. The last experiment may be performed by heating a little starch and sugar in an iron spoon until they take fire. It will be seen that the solid substance only glows, but that the flame is a burning gas which rises from the solid matter. The starch and sugar are really being heated in a closed space, shut off from the air by the spoon below, and the burning gas above. In like manner, in the case of wood fire, they can see that the flames are caused by the burning of the combustible gases given off from the hot wood.

The children will now be able to describe the results of their experiments with sugar and starch, and to state and justify their conclusions as to the composition of both. They will doubtless conclude that, like wood, starch and sugar are probably composed of charcoal and water chemically united. They may then be told that sugar, starch and wood and several other substances of similar composition are called carbohydrates. The fitness of this name should be shown from its derivation.

In all this work the teacher is supposed to act only as the director of experiments and as the referee in deciding the validity of the arguments and inferences. His skill is measured by the success he has had in inducing each pupil to do his own observing and thinking independently.

After a careful review of the whole ground, the children should retain a good working idea of chemical union—will see that heat tends to separate substances that have been chemically united—will understand what agricultural lecturers mean by carbohydrates—will

know that when carbohydrates are heated in a closed place until they decompose they break up into carbon, water, and other substances liquid and gaseous—will see that a flame is a burning gas, and that a solid, as carbon, burns without a flame—and will be able to form an intelligent conception of many processes in nature and the arts which would otherwise be quite inexplicable.

JOHN BRITTAIN.

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FREDERICTON, N. B.

SCHOOL-GARDENS

BY F. W. SHATTUCK

Secretary of the School-Garden Association, Boston

"School-gardens should be laid out neither to draw the attention of passersby nor to give great returns, but to instruct." Keeping this in view the School-Garden Association has provided a list of seeds to illustrate distinct types such as bulbs, roots, vines, branching and heading tops among vegetables, and flowers that climb, grow in spikes, clusters, or on single stems, that can be used to form borders, and to relieve by their brilliant colors.

To place the seeds within the reach of all, they are furnished in collections of five packets in an envelope at the rate of one cent per packet. In this way all the pupils of a school can be provided with at least one packet of seed without imposing a burden on anyone.

The interest in the school-garden movement is becoming widespread, communications coming in from nearly all the states and provinces of the United States and Canada. While this interest has been worked up by means of addresses in educational conventions, articles in the teacher's journals, by circular letters and by the formation of school-garden clubs, home garden associations and the like, it has become apparent that systematic effort must be put forth in order to secure any permanent results of value. It is an easy matter to arouse the interest of children and induce them to plant vegetable and flower seeds, but unless their efforts are sustained through the season and encouraged by generous recognition and some rewards, the results will not be substantial. If, however, there is an active

organization of interested persons to promote the movement and give the right encouragement thereto, the most gratifying results may be obtained. This has been exemplified in a very marked degree by the Home Gardening Association of Cleveland, Ohio, whose reports show that they have interested a large part of the community in gardening and in the improvement of home surroundings, and that the annual number of seed packets distributed through this Association has reached very many thousands. This result, however, has only been reached by active and continued work by the members of the Association by the appointment of committees to visit and inspect the gardens of the children and to encourage them by exhibitions for their products and by prizes. In this way, a general interest has been aroused among the parents and the possessors of homes to the extent of developing general interest in gardening.

The conclusion may be drawn that the conditions exist for the easy development of a large increase in gardening. The number of gardens and flowers may be multiplied not two or three, but very many times, and this by the latent and surplus energies of children ready and eager for the work.

The Massachusetts Horticultural Society is doing pioneer work in this direction through its Educational Committee, in establishing prizes for individual effort, and for school-gardens open to the whole state. Work of this kind will result in great good to the community, and this movement should be prosecuted with the same systematic effort that is being put into manual training.

THE TEACHER VS. A FIXED COURSE OF NATURE-STUDY

BY T. R. CROSWELL

Los Angeles, Calif

There is a decided difference of opinion as to the best method of arranging the course of nature-study for a system of schools. Some leaders would outline in detail the work of each grade, and would expect this outline to be followed closely; others would indicate the course only in a general way, and would encourage the individual teacher to pursue that line which she knows most about and in which she has the greatest interest. I believe the latter is the correct posi-

tion at the present stage in the development of the subject, and that there are good reasons why this latitude will continue to be necessary to a much greater degree than with most subjects.

There are likewise some very plausible reasons why we should outline with the greatest care just what is to be done. Such precision will result in more pupils studying the subject, in greater definiteness and uniformity of subject-matter, in more teachers attempting to instruct classes in nature. In brief the greater the exactness with which we arrange a course the sooner will we have nature-study in our schools, the sooner will something be accomplished, and the sooner will we have something to show our patrons. If we have "something to show," they will doubtless be satisfied; they usually are under such conditions. Perhaps we too will be satisfied; some of us at any rate.

But really should we be in such haste to have more nature-study in our schools? Will it be better to have it in name throughout the schools, or to have the genuine thing in spots, and trust that the time may come when vital contact with nature may be more universally a part of the teacher's equipment? At the present time it is as great a misfortune "to study nature" under many of our teachers as it was a few years ago to study music under the average teacher. Teachers may be as deficient in one of these subjects as in the other and the effects of their instruction instead of being merely negative may be positively detrimental. Interest killed or wrongly directed is a sad thing to contemplate. A definitely outlined course for the guidance of teachers not equipped for this subject emphasizes at the start one phase and foreordains that it shall be followed, for most nature-study outlines give undue prominence to the information side. With such courses to follow the teachers naturally turn to their books instead of putting questions to nature and in many cases the whole subject degenerates into a memorized jumble of names, an acquisition of disorganized and often useless facts, with the very minutest sprinkling of vitalizing contact with living things.

"Nature-Study and Life" implies such a contact with the creations of nature. It is because of this belief in the importance of some such contact that the interest in the subject during the past decade has been so general and so genuine. The more mechanical a subject the greater the number of teachers who may be expected to be proficient drill-masters in it; the more a study becomes a matter of real insight and appreciation the more the personality of the teacher counts. And so

we find the occasional teacher in literature, drawing, music, or nature-study who is able to do really good work, who interests, instructs, and inspires her pupils. In some of these subjects fairly definite courses have been evolved, and some knowledge of method obtains with the majority of our present teachers. Unless, however, a teacher enjoys the piece of literature which she teaches, little good can be expected from her attempt to lead others to it. The same is true of the teaching of nature-study. If it is to be vital, it must be that phase of nature which has already touched the life of the teacher. Such a teacher will give freer expression to herself and richer content to the subject.

Fortunately it is neither possible nor necessary to teach all of nature to any child. Indeed when we begin to outline the course grows and grows until supervisor, teacher, and pupils are overwhelmed by the profusion of material. On the other hand the genuine study of one thing as it should be studied is worth more than the perfunctory study of nature through the whole course. Better the inspiration given, the interest awakened, and the method taught in one term by a true lover of that which she teaches than years of the aimless stagnation predetermined by some complete course in nature-study.

Empirical study of the nature instruction which has come under my observation leads to the same conclusion. That work which was of unquestioned value, which invoked the keenest interest, which resulted in sustained and spontaneous effort, and which taught them how to study some definite problem, was invariably done by a teacher who had been priviledged to select with the widest possible freedom that particular field in which she and her class were to spend a term. Sometimes she has chosen a line of work that she herself had pursued under a competent instructor, but the very best of this work has been guided by some teacher trained in biology who chose and worked up a field from her own special interests. Examples of such courses are among the most helpful contributions which can be made to nature-study in its present evolving state. I hope to induce some of my acquaintances to report upon their experiments. Perhaps other readers of THE REVIEW may be able to do the same. Thus by suggesting new lines of study, as Hodge has done so fruitfully in "Nature-Study and Life," the possibilities of selection will be widened until more teachers will realize wherein they may give to others a taste of that which Dame Nature has given to them. For indeed the very best we have may be so common, so a part of ourselves that we

never dream that it can be of value to others. With such freedom and range of selection fewer pupils may study nature than would were the course less elastic, but the value of this study will be beyond question and its relative standing in this curriculum will be assured.

NOTES ON RECENT PAMPHLETS

Georgia School Gardens. The Geo-gia School Improvement Club has issued a very useful leaflet on gardens by Miss Lucy L. Davis of the State Normal School.

Lessons in Nature-Study. A leaflet for rural and ungraded schools, by Etta M. Bardwell, Ottumwa, Ia. Contains numerous suggestions valuable for the teachers who need definite guidance.

Wisconsin Bird Study Bulletin. An interesting pamphlet of 28 pages, illustrated by inserted colored plates from a well known publishing house. The birds selected are common ones in all parts of the state. Other bulletins will extend this bird study. The authors are Mr. and Mrs. I. N. Mitchell, of Milwaukee; and the State Superintendent of Schools is the publisher.

Wisconsin Arbor Day Annual. A pamphlet of selected literature for Arbor Day programs. It also includes a few articles on value of trees. Issued by C. P. Cary, State Superintendent of Schools of Wisconsin.

Humane Education. A bulletin to aid teachers in carrying out the provisions of the California law prescribing instructions in humane education. It is essentially nothing but a course in nature-study with special emphasis on treatment of animals and plants. The topics are: pets (cat, dog, birds); domestic animals (horse, cow, sheep, fowls); wild animals (birds, fishes, mammals, insects, frogs); game laws of California; bibliography. Throughout the course unnecessary and wanton injury or destruction of either plants or animals is strongly opposed. Of course this has long been done by many teachers of nature-study; but it will be worth while for teachers to read this pamphlet and get the point of view and suggestions of the writers who have specially studied the moral value of nature-study. The bulletin is issued by State Normal School, San Diego, Cal.

Pennsylvania Bulletins of Zoology. The monthly bulletins issued by Professor H. A. Surface, Economic Zoologist for the State of Pennsylvania,

are valuable for all who are interested in the practical applications of biology. Injurious insects like the San Jose scale are especially well treated. The 25,000 copies regularly issued must certainly be doing a great work for the agricultural interests of the State.

Nitro-Culture. The experiments in inoculating soil with certain species of bacteria which will develop on the roots of legumes (beans, pea, clovers, and similar plants) and store up nitrogen food for plants, are quite familiar to all who even occasionally glance at agricultural journals. Numerous failures in attempting inoculation of soils from the packages of dried cotton sent out by experiment laboratories have been discouraging to some agriculturists. Bulletin 270 from the Experiment Station at Geneva, N. Y., points out that the method of drying on cotton is the cause of the failures, and that improved methods of distributing bacteria must be adopted.

NATURE-STUDY AND SCIENCE NOTES

Do Snakes Charm Birds? A writer in *Bird Lore* for August concludes from his own observations that snakes do not charm birds; but that the parent birds attempt to drive the intruding snake away and becoming bolder and bolder finally come within striking distance of the snake. Have any readers of THE REVIEW made observations in this line?

Protection of Native Plants. At the 1906 annual meeting of the Society for Protection of Native Plants, Professor Fernald, of the Gray Herbarium, pointed out that with the disappearance of woodlands many delicate wild flowers disappear and in the cleared space coarser flowers like goldenrod and asters flourish. Over six hundred weeds of the old world are already here and rapidly spreading where woodlands formerly existed. Spots of woodland under natural conditions should be reserved for the vanishing native plants. [*Plant World.*]

Swans in New Zealand. The black Australian swan is nearing extinction in its native home, but the same species introduced into New Zealand has flourished. Great flocks of five and six thousand individuals may be seen, and ducks and geese are being driven away. [1905 Report of N. Y. Zoological Society.]

Diamonds in Brazil. The finest diamonds come from Brazil and not from South Africa as is popularly believed. Along with the diamonds occur

carbons, which are so extensively used in the so-called diamond drill used in cutting hard stones that within fourteen years the price has advanced from $17 to $60 per carat. One carbon found in 1895 weighed 3,165 carats; it sold at the mine for $16,000; when broken into pieces of 2 to 4 carats suitable for drills it sold for $40,000; today it would bring $158,000. [*Popular Science Monthly*, 69: 272, Sept., 1906.]

The Oyster Industry. In the recently revised edition of "The Oyster," by Professor Brooks of Johns Hopkins University, (published by the University, Baltimore) there are many interesting statements regarding the oyster industry. Records have been kept since 1865 and since that time more than four hundred million bushels of oysters have been taken from Chesapeake Bay. The natural beds at present occupy two hundred square miles, but five times this area is suitable for oysters and will ultimately be planted by the oyster farmers. The author outlines what should be done towards making the present beds as productive as formerly and extending the beds.

Strength of a Beetle. A writer in a recent number of *Nature* (London) notes a case where a beetle was able to lift up the edge of a box which weighed more than 1700 times more than the insect.

Age of Tortoises. A note in the September number of THE REVIEW on the giant tortoise of Galapagos Islands refers to the great length of time required for these animals to reach adult size. I would call attention to notes published by Mr. Edmund Heller in Proceedings of the Washington Academy of Sciences, Vol. 5. Mr. Heller (now of Field Columbian Museum) spent twelve months in the Galapagos Archipelago and made careful observations on the species above mentioned. His observations on growth show that a young specimen taken when twenty-nine pounds in weight doubled its weight in twelve months. A specimen was brought to Riverside, California, in a sack. In spite of the great change in climate the specimen has continued to grow and when I saw it last summer (Aug. 1906) it had attained a weight of 295 lbs., in seven years' time. The total shell length was over 36 inches. This may safely be considered adult size, as the largest specimen Mr. Heller reports measuring in the Galapagos Islands was 115 centimeters or about 44 inches. The Galapagos group is situated under the Equator where there is little time during the year that the animals would not feed and grow. In California there are some months of quiescence during the year when no growth occurs. The impression that these animals grow at an exceedingly slow rate seems then to be decidedly erroneous. The figures now before us ought to correct that impression.

LOYE HOLMES MILLER.

STATE NORMAL SCHOOL,
LOS ANGELES, CAL.

Herring Gulls Killing Young. A writer in *Science* (Nov. 9, 1906) has observed numerous attacks committed by the adult gulls upon their young, killing and severely wounding. There was no evidence that the birds attacked were weak or otherwise abnormal. The young were about half grown. Notes on similar observations by others are wanted.

Deer too Numerous. Under the protection of the game laws requiring a long close season deers are becoming numerous in many localities in New England and are doing considerable damage to garden and farm crops. It will be necessary to enact laws for an open season in order to reduce the numbers. [*Shield's Magazine.*]

Crayfish Industry. From the Potomac a half million crayfish are annually shipped to the New York markets. Many other rivers in Florida, Louisiana, and other southern localities supply crayfishes. One county in Florida in 1902 shipped nearly 56,000 pounds (3 pounds to the dozen), value nearly $3,300. In Oregon the annual catch is often more than 100,000 pounds, worth over $7,000. In 1899 the wholesale business in Portland amounted to nearly $20,000. Such statistics are incomplete, but they show that large numbers of crayfish are annually sent to market. The demand is increasing. Artificial breeding will be necessary. Professor Andrews, of Johns Hopkins University, has raised them in his laboratory. They laid eggs (200 to 600) when one year old, and grew to marketable size (3 inches) in two summers from the egg. Probably in nature they are full grown in four or five years. The Oregon crayfish (Astacus) grows much more rapidly and might profitably be introduced into rivers east of the Rocky Mountains. [Notes from article by E. A. Andrews, in *Science*, June 29, 1906.]

Sweet Clover. The common melilotus or sweet clover (Melilotus alba) of our roadsides is classed as a weed in the laws of many States. *Gleanings in Bee Culture* points out its value as a honey plant and as a support for unprotected soil of embankments into which the melilot roots grow readily. The plant gives no trouble in cultivated fields. There seems to be no good reason why it should not be placed with the useful plants and the laws should be changed so as to allow the growing of sweet clover on otherwise unprotected embankments.

Red Clover as a Honey Plant. Italian bees gather more honey from red clover in some seasons than in others. This is connected with the fact that the corollas are shorter dry seasons and the bees can work them more rapidly than the larger tubes of wet seasons. Also certain soils produce rank growth of long corolla tubes and hence the value of red clover for bees may vary with localities. [*Gleanings in Bee Culture.*]

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DEVOTED TO ALL PHASES OF NATURE-STUDY IN SCHOOLS

CONTENTS

	PAGE
A Day's Work in Bird-Land. EDNA R. THAYER	289
Keeping and Rearing Crayfish. E. A. ANDREWS	296
Direct Methods of Studying Nature. LILIAN J. CLARKE	302
Notes on Animal Behavior. A. W. WEYSSE	311
Editorials	313
Notes on Pamphlets and Magazines	314
Nature-Study and Science Notes	316
News Notes	319

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A DAY'S WORK IN BIRD-LAND

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[EDITORIAL NOTE.—This most interesting record of some careful and patient observing ought to stimulate more such work as well as give information. If other readers of THE REVIEW have made similar studies, notes are wanted for publication.]

An eight-hour working day, from eight to twelve and one to five, is the cry of the times, and you have doubtless heard the story of the workman who left his pick-axe suspended in the air at the stroke of five in order not to work overtime. Search as we might, we should find but a few rare souls who would be willing to work twelve hours in a day and beyond that I fear we should call it not work but something akin to slavery.

But of a day's work in bird-land, how little we really know! We have read that in Massachusetts the birds eat twenty-one thousand bushels of insects in a day; and in Nebraska one hundred and seventy carloads. In Iowa the tree-sparrows are supposed to eat two and one-third tons of weed seeds daily. And perhaps the most marvelous estimate of all is that a young robin eats so many insects in a day that if a man should eat in like proportion he would require a bologna sausage three inches in diameter and sixty feet long.

These are probably as accurate as estimates may be and help much toward a truer appreciation of the value of bird-life to a community, but actual facts are doubly convincing. And so in last July when Professor Hodge, of Clark University, was invited to spend a week with the students of the Biological Station of the University of Indiana, at Winona Lake, and direct their studies of birds he planned days with the birds.

On two mornings the class of twenty-three members met on a con-

venient hillside, once shortly after three o'clock, and once before three, and after a luncheon of crackers and milk, were ready to listen to the first notes of the pewee, the wood-thrush, and the cardinal grosbeak, to be followed a little later by a grand chorus of the awakening voices of bird-land.

Then came the great day July 13, when the class was divided into relays, and each given hours in which to watch a certain pair of birds. We had discovered many nests, but because of accessibility and convenient hiding places for observers, we chose those of an orchard-oriole, a pewee, a phoebe, and a wren.

Now we meant to find out what these birds did in a day—just how much work they did, just how much relaxation they had, and we were prepared for the longest day's work we ever did.

The first relays were at the appointed places before the first dawn of day, and the last left only after the male birds had flown away to their resting-places, and the females had retired for the night. There was no moment from dawn till evening when the opera-glasses were not focused on the nests and no movement of the birds passed unnoticed.

Now for the facts gained: The report of the orchard oriole was given by Mr. John H. Brackemyre, Miss Edith Holloway, Miss Bertha Hormell, Miss Eulala Hormell and Mr. Frank H. Wheeler.

There were two young birds in the nest, which was in a small peach tree, about six feet from the ground, and observation began at 3:30 A.M. and continued until 6:47 P.M., making fifteen hours and seventeen minutes.

Feeding began at 4:35 A.M. and ended at 6:10 P.M. The young birds were fed sixty-nine times, five times only by the male bird; and the average time between feeding periods was twelve minutes. From 4:35 A.M. to 10 A.M. the average time between feedings was eight minutes;—from 10 A.M. to 2:45 P.M., sixteen minutes; from 2:45 P.M. to 3:45 P.M., eight minutes; from 3:45 P.M. to 6:10 P.M., thirteen minutes.

When the female approached the nest, she always looked, warily about and paused on a dead limb near the nest, from a few seconds to five minutes before entering, but the male darted in at once without fear.

Twice during the forenoon the female brooded her young thirty-four minutes and twice in the afternoon for seven and eight minutes.

The food consisted principally of locusts and green caterpillars, presumably cabbage, of which there was an inexhaustible supply near by.

The observations on the pewee's nest were made by Mr. Arthur W. Carnduff, Miss Neva Galbreath, Mr. Elliott Crull, Miss Mary Hormell, Miss Margaret Hines and Miss Ruby Hull, in relays of three hours each.

The Pewee's nest was a small, prettily built one of grass and rootlets, covered with lichens, and was about ten feet above the ground upon the gnarled limb of an old apple tree. In the nest were two white eggs, with brown spots about the larger end. The pewee was not in the least shy, and seldom left the immediate vicinity for more than a minute or two. As there were no young, all food obtained was for her own use. She left the nest at 3:30 A.M. and was active until 5:50 P.M., a period of fourteen hours and twenty minutes, when a shower which had been threatening for two hours seemed imminent and observations were suspended. During the day, she caught 208 insects, some flying in the air, some on the apple tree and others in the grass. Her favorite position was on a dead limb. The total time spent in incubation was five hours and thirty-five minutes, the average length being ten minutes, and the longest time sixty-nine minutes, from 6:59 A.M. to 8:08 A.M. The number of insects caught and the incubating periods were as follows: From 3:30 to 6 A.M.; 15 insects; 31, 7, 11 and 6 minutes. From 6 to 9 A.M.; 12 insects; 10, 14, 13, 69 and 9 minutes. From 9 to 12 M.; 28 insects; 2, 14, 9, 4, 14, 11 and 4 minutes. From 12 M. to 3:15 P.M.; 108 insects; 16, 8, 18, 2, 5, 11, 4 and 9 minutes. From 3.15 to 5:50 P.M.; 45 insects; 12, 5, 2, 3, 5, 4, 7, 4 and 20 minutes.

The male visited the nest frequently, and was usually at hand to drive away sparrows or other intruders.

The call-note, "pewee," was uttered oftenest during the hours of most active feeding, from 12 M. to 3:15 P.M. and less frequently toward night.

Four days later, we found the pewee's nest deserted, and the eggs gone. The bluejays were very numerous about and doubtless knew what happened to the pewee and her eggs.

The phoebes were observed by Miss Nellie Bigham, Miss Sara Carmony, Miss Dewie Jones, Mr. Frank Thompson, and Mr. Frank Dale Thompson.

The nest was made of grass and mud and was located on a beam

near the roof of the porch of an empty cottage. It contained two young ones four days old.

The male and female birds closely resembled each other; in fact, it was difficult to distinguish one from the other, but the male had a slightly larger crest, longer bill, and was somewhat brighter in color.

Not once during the day was the call-note heard; they were doubtless too busy.

Observation began at four o'clock. The female left the nest at 4.20 and from then the birds fed their young as follows:

From	4.20 A. M.	to	5.20 A. M.	19	times.
"	5.24 "		6.20 "	18	"
"	6.20 "		7.20 "	39	"
"	7.20 "		8.20 "	36	"
"	8.20 "		9.11 "	26	"
"	9.11 "		10.17 "	31	"
"	10.17 "		11.01 "	17	"
"	11.01 "		1.07 P. M	17	"
"	1.07 P. M.		2.12 "	11	"
"	2.12 "		3.45 "	15	"
"	3.51 "		5.11 "	15	"
"	5.11 "		6. "	16	"

The two birds returned at 6.20, presumably from a bath for they preened their feathers. And from 6.20 to 7 P.M. the young fed 6 times. At seven it began to rain, and became too dark to see well. The female retired to the nest at 7.12 P.M. The total number of feedings was two hundred and sixty.

Eleven days later, July 24, just as the young phoebes were about ready to fly, the cottage burned and no one had thought of the phoebes until they came fluttering to the ground. Eager hands picked them up and I rushed them to camp and swathed them in vaseline and cotton. An hour later, both were crying for food. For four days I fed the birds, mostly with locusts. Each day I planned to count the insects, but catching and feeding them took all my spare time. Then I found a phoebe which seemed quite willing to adopt a youngster when placed in the nest with her own, and I glady relinquished my claim upon one. The other phoebe had been badly burned, was practically minus feathers, and was in a dilapidated condition save his voice and stomach. For eleven days I fed him from one hundred and fifty to two hundred locusts and other insects each day. The feathers began to grow again, his eyes grew bright, and I was hoping a speedy flight when an accident befell him and he had to be killed.

The fourth nest, the wren's, was found deserted on the appointed

morning and another was immediately sought. It was found at nine o'clock, and observation began twenty minutes later, ending at 6:46 P.M. when rain began, the total time being nine hours and twenty-six minutes.

This nest was in an apple tree, about thirty feet from the pewee's nest; and was in a woodpecker's hole in a branch so rotten that a slight pull broke it and disclosed the nest. Repairs were made with a couple of shoe-strings, but many times during the day both birds wandered up and down the cracks as if to ascertain what had happened to their home.

There were five birds about three days old in the tiny nest, which was made of twigs, feathers and soft grasses.

Mr. Allan C. Richardson, Mr. Fred Bourn, Miss Nora E. Bourn and I chose to watch the wrens. We were more fortunate than some of our associates, for the male never but once approached the nest without giving utterance to the most captivating little song, no matter how large an insect he had in his bill, and rarely did his mate fail to show herself and daintly take the choice morsels as he leaned over her. He was such a charming little bird, showing the little mother every attention, yet withal keeping the young provided with food. Food which consisted of cutworms, grasshoppers, cabbage-caterpillars and black insects which we could not identify, was brought to the nest one hundred and thirteen times, with an average of twelve insects per hour.

The male brought food ninety-one times and the female, twenty-two; by hours as follows:

	Male	Female
From 9.20 A. M. to 10.20 A. M.	15 times	0 times
" 10.20 " 11.20 "	10 "	0 "
" 11.20 " 12.20 P. M.	6 "	0 "
" 12.20 P. M. to 1.20 "	13 "	0 "
" 1.20 " 2.20 "	9 "	1 "
" 2.20 " 3.20 "	10 "	1 "
" 3.20 " 4.20 "	5 "	10 "
" 4.20 " 5.20 "	5 "	9 "
" 5.20 " 6.46 "	18 "	1 "

We wished to know more of this little wren family, so four days' later, Miss Bourn and I seated ourselves in the orchard near the wren's nest at 3.30 o'clock to be ready for the "Good-morning." It was 4.24 A. M. when the male came singing, and in an instant, the female appeared at the opening. Then began a busy day, the wrens feeding

their young two hundred and thirty times, an average of sixteen to an hour, but things had changed in four days. On the former day the male brought three-quarters of all the food; now that the young needed less brooding the birds seemed to vie with each other in their efforts to provide a bounteous table. The male brought food one hundred times and the female one hundred and thirty times, the food being apparently of the same character as that of four days before. Hour by hour, the feedings were recorded as follows:

	Male	Female	Total
From 4.24 A. M. to 5.24 A. M	14	0	14
" 5.24 " 6.24 "	9	5	14
" 6.24 " 7.24 "	6	8	14
" 7.24 " 8.24 "	10	14	24
" 8.24 " 9.24 "	6	12	18
" 9.24 " 10.24 "	7	11	18
" 10.24 " 11.24 "	6	9	15
" 11.24 " 12.24 P. M	6	13	19
" 12.24 P. M. to 1.24 "	6	6	12
" 1.24 " 2.24 "	2	8	10
" 2.24 " 3.24 "	5	14	19
" 3.24 " 4.24 "	8	9	17
" 4.24 " 5.24 "	6	2	8
" 5.24 " 6.24 "	4	7	11
" 6.24 " 7.38 "	5	12	17
	100	130	230

The male seldom went inside the nest, but gave the food to the female if she were within, or else balanced himself on the edge of the opening and reached into the nest fluttering his wings continually. The female always went inside. When either bird appeared a quintet of voices called lustily, and during the afternoon the young responded when the male sang, as he very often did, from a neighboring pile of brush.

The female never stayed in the nest more than two or three minutes at a time, and the male was ever on the alert, even while he sang betimes on the brush.

All excreta were removed by the female to a distance of fifty feet or more from the nest.

At 8.35 A.M. the female returned to the nest after fourteen minutes absence, with wet feathers, indicating that she had been for a morning dip, and at 8.44 A.M. the male appeared in like condition. In the afternoon, at 5.43, both birds disappeared once more, returning shortly with feathers again wet, and preened just outside the nest.

The male guarded jealously his premises, and he allowed no intruders. Once he seized a large bumble-bee which had alighted near the nest, and flew away with it.

Some bread which I had placed on the brush-pile to see if the wrens would eat, he seemed afraid to touch, but he would not allow the English sparrows which came up, hoping for a feast, to get a taste.

We watched the wrens nest together for sixteen hours and eight minutes, or until 7.38 P.M., except that in two hours of that time we took turns in going to breakfast and dinner. It was a strenuous day, but if so to us, sitting comfortably on our cushions, what must it have been to those tiny creatures which like the canary of Dickens' Little Nell were "so slight the pressure of a finger would have crushed."

The accurate facts which we sought are ours. We no longer think the estimates made by ornithologists as to the birds' eating capacity large; but we wonder if they are not too small.

As we return each into his own little world once more, we—many of us teachers in the public schools—will carry a new impetus to work for the preservation and protection of bird-life, realizing that—

"The life that floods the happy fields
With song and light and color,
Will shape our lives to richer state,
And heap our measures fuller."

THE KEEPING AND REARING OF CRAYFISH FOR CLASS USE

BY E. A. ANDREWS

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[EDITORIAL NOTE.—Dr. Andrews has for many years been making an interesting series of studies of crayfishes kept in his laboratory. Some of his recent articles in scientific journals suggested to the managing editor of THE REVIEW that the methods of keeping crayfishes alive in perfectly healthy condition ought to be widely known; and so Dr. Andrews was urged to write some notes on his experiments. The following article contains many practical suggestions for elementary schools, many more for high schools, and every line is useful for college. In fact the article is one of the many already published which establish the claim that THE NATURE-STUDY REVIEW is "devoted to all phases of nature-study in schools,"—not simply for elementary schools as originally planned, but for all schools in which it is desirable to give pupils and students some personal acquaintance with the common natural things considered independently of scientific organization.]

Thanks to its standing high in the great phylum, Arthropoda, and to its size, neatness, world-wide distribution and ease of getting, the crayfish scarcely needed the advertisement given by Professor Huxley's classic book to place it in the first rank of animals that find favor in the eyes of the teacher of zoology. In fact the crayfish amongst non-vertebrates plays much the same part as the frog amongst vertebrates in teaching our ideas of morphology.

Since crayfishes are so extensively used by the angler as bait and by the epicure as garnish and as food, they are generally easily obtained in the markets and it is scarcely necessary to keep them long in the school if they are to be used merely for brief anatomical studies. But when more than this morphological study is the aim it is important to know how to keep the creatures alive, and the following suggestions may prove of value.

These suggestions result from observations made in the climate of Baltimore, Md., upon the common crayfish, Cambarus affinis, C. Clarkii, C. immunis, C. Diogenes and C. Bartoni; and with some change they should be applicable to all American species of crayfish.

To the teacher without experience with these animals the chief pitfall is, perhaps, the idea that crayfish must have deep water, whereas the first essential is air and not water. Left in deep water the

animals soon respond to foulness or to lack of oxygen in the water and try to climb up to expose themselves to the air at the surface. They resort to deep water chiefly for food and for protection. To thrive in confinement the crayfish needs air and only enough water to keep the body from drying up and to contain food. Hence, flat dishes or sinks, or tubs, or aquaria with very shallow, running, water will sustain an unexpectedly large amount of crayfish. Even when there is no running water the crayfish will live many days if allowed a chance to expose its gills to the air at the surface. When large numbers are to be kept and a special receptacle has to be made a long wooden box, painted inside with paraffine, is to be recommended. If one end of the box be raised and water kept running through so that the depth will grade from nothing at the inlet to a couple of inches at the outlet end, the crayfish will have a range of conditions to choose from. Porous bricks or tiles may be used to partition the box, if desired, and also to make very acceptable climbing and hiding places for the crayfish. If the sides of the box are not deep enough to keep the crayfish from climbing out, some eight inches or more, the box must be covered.

When there is sunshine enough to make aquatic plants thrive a few crayfish may be kept in balanced aquaria. Even C. Bartoni, which is a native of cold brooks, was kept for months in a small aquarium with abundance of living algae and Elodea, but with no change of water. Small numbers may be kept in water which is often changed by hand and also in aquaria aerated by air forced in.

Next to abundant air supply the temperature is to be considered as a factor in success if one is to keep large numbers of crayfish alive. The lower the temperature the better for holding the stock through the winter season, and at other times too high a temperature must be avoided and extra areation insured when the water is unavoidably warm.

Food is a matter of less importance as most of our crayfish are dormant or inactive during a considerable part of the year and even in the warmer seasons when they need food they can withstand long fasts. In the spring they generally take food eagerly; eggs, meat, worms, potato, bread, crayfish flesh, molluscs, Chara and other aquatic water plants and algae, in fact most kinds of soft organic matter, will often be consumed. A not inconsiderable amount of fine sediment, or ooze, from the bottom of the aquarium is also collected and eaten by crayfish that are kept in conditions more like those in nature.

At the best every crayfish is not always hungry and removal of excess of food and change of diet seem here, as elsewhere amongst animals, to increase the chances of long life. With running water and a varied diet crayfish have been kept alive and breeding for three years in small sinks in this laboratory.

Yet mortality from unknown diseases may occur and after the breeding season many males may die, and, eventually, a limit to their life seems reached in a few years, judging from experiments made by the writer.

While the crayfish is so well known and extensively used for anatomical and morphological study, it is also a most excellent subject for study of comparative psychology and of animal behavior. More than that, it is, we find, unusually well fitted to show students scenes in an entire life-history of an animal large enough, common enough and complex enough to interest all pupils and at the same time not too much like a human being. Any school that has running water and six square feet of sink space to devote to this purpose may hope to present to the pupils in three months the fundamental facts of sex and of egg laying and development, of maternal instincts and of larval life; while within a year the whole cycle from egg hatching to egg laying again may be watched in the same animal.

The following method of rearing crayfish apply strictly to C. affinis which lays its eggs in the spring; some other species have other breeding seasons and less ability to endure the artificial conditions of captivity. Specimens of C. affinis are shipped in large numbers to the New York markets and they may be obtained directly from Mr. L. Davis, Accokeek, Md., at prices varying from one to five cents each according to the season and number purchased.

If the crayfish are obtained in the autumn or in the winter the sexes may be keep together till about the middle of March, unless it be thought desirable to study the remarkable and instructive mating habits. In that case a male should be kept in a small dish till accustomed to it and then a female of like size introduced whenever the process of pairing is to be observed. If properly understood these phenomena have too deep an educational value to be left out of the study of the whole life cycle.

In March the females may be put into dishes of running water by themselves, one, or but few, in each dish. The indication that a female Cambarus is likely to lay eggs is that the annulus ventralis shows a white speck, or plug, projecting from its orifice. And

such a female will predict the time it is going to lay by a most noteworthy process of cleansing that goes on several days before the eggs are laid and which should be carefully studied as a purposeful instinct.

The female about to lay should, preferably, be kept little disturbed and with one corner of the dish screened to give shade.

The actual laying will, with rare exceptions, take place in the night and the next morning the pupils may dimly see some hundred of eggs held enclosed in a mass of mucus under the abdomen. A strange habit exhibited at this period, a rythmic lying down and rolling over, is not to be interpreted as a sickness but as a necessary part of the complex series of phenomena concerned in the fertilization of the eggs and in their firm fixture to the abdominal appendages of the female. To insure the fertilization and future development of all the eggs it is well to leave the female undisturbed for a couple of days till the mucus is gone and the eggs firmly fastened, each by its own strong stalk.

From that time on for a term of five to eight weeks, which according to the temperature, will be necessary to bring the eggs to the hatching period, the crayfish may be lifted out of the water whenever desired and a few eggs removed for closer observation.

In this long time the pupils should look for evidences of maternal care in the treatment of the eggs.

It is evident that any class meeting in April and May may expect some material to show stages in the development of the eggs and as each female lays from three hundred to six hundred eggs it is easy to have an adequate supply. In watch-glasses and strong light even a pocket-lens reveals stages in cleavage and shows many of the forms of embryos figured by Reichenbach, by Huxley, and in text-books of zoology and embryology. With a compound microscope available for demonstrations, the brilliance of the pigment, the beat of the heart and the flow of the blood, in fact the livingness of the embryo within its shell are most fascinating and give the students hope that the long expected hatching will take place; and it will after about two more weeks.

With time, skill and apparatus the teacher could utilize the material presented for unlimited illustrations of the mere special facts of crustacean embryology; if that were advisable. The first week of incubation would supply eggs in cleavage stages, the second the beginning of the embryo, the third the "nauplius stage," the fourth

the embryo extended over one half of the egg, the fifth and sixth the slow perfection of an embryo ready to hatch.

The younger, smaller, females often lay later than the older, larger ones and if several females of different sizes have laid, the chances will be better for an extension of the hatching period over hours when the pupils may be on hand to see the actual hatching process. When it is seen that a few eggs have changed to fluffy, pink masses, one of the abdominal appendages may be cut off with its load of eggs and in a watch-glass some of these eggs may be seen to let out very slowly the imprisoned young.

During some days the pupils will have ample opportunity for trying to find out how the young after hatching become connected to the parent and what their condition of development, as compared with the adult, really is. Ultimately the young will leave the parent but there is a long and most interesting period of association of mother and offspring that may profitably be studied by the student from a standpoint like that taken by Roesel von Rosenhof in 1755, or if the teacher will so have it, from a more fashionable standpoint of "tropisms."

The active larvæ are extremely attractive under the lens and for that vast majority of pupils who cannot hope to see living pelagic organisms these crayfish larvæ in their brilliant pigmentation and translucency may well serve as a convenient substitute.

Once the young begin to make extensive excursions away from their mother's apron strings, fine wire net must be used to prevent their loss in the overflow of water. Whenever the mother is fed the conduct of the young should be observed and the large problems of interrelation of parent and offspring considered.

If well fed the young will shed their shells from time to time and measurements of growth at these times may well be made.

Questions as to the intelligence, instincts, education of the young, naturally arise and experiments may be devised to limit one's ignorance. If it is desired to keep the young isolated from association with others and to show their innate acts the eggs may be removed before hatching and pinned, by the egg stalk, to floating corks in running water where they will hatch out alone and without association with others.

The larvæ may be fed minute pieces of meat with good supplies of water plants and of ooze to choose from. The red tailed oligochæte, so common in polluted streams, may be kept in stock and will furnish a food-supply much appreciated by the young crayfish.

Where a school provides two years work in biology, it will be possible to have a class follow the same larvæ to maturity; otherwise each class must be content to see the maturity of young started by the preceding class. To rear the young to maturity it is necessary to keep them during the summer vacation and this will require some attention, at intervals of a week or so, from an attendent or person capable of following some few directions. Several broods of young may be put into a sink or box two by four feet or more and eight or nine inches deep, placed before a window so that aquatic plants will thrive in it. A small stream of running water is necessary. The tank should have two inches of mud and three of water in it and be well stocked with Elodea, Chara or any other plants that will grow under water. Snails, river clams, dragon-fly and other insect larvæ and Tubifex are good additions.

The outlet pipe must be guarded by wire net and possible overflowing prevented by periodical inspection. From time to time bits of egg, meat, bread, or portions of freshly killed crayfish, should be put in for food; but in this it is repetition rather than quantity that is to be aimed at.

In the autumn some few survivors should be on hand to greet the pupils and if these young crayfish have been well fed they will be sexually mature, even though but two inches long. If allowed to lie torpid in cold water during the winter some of the small crayfish may be expected to lay eggs the following spring though they will st ll be of the same small size.

The complete life cycle is thus ended within twelve months and while this is a long period in comparison with what may be chosen amongst insects, yet for so large an animal it is but a brief time and as far as it is followed by the pupil it will furni h opportunity for training sustained interest in one complex object that illustrates many fundamental phenomena of living things.

DIRECT METHODS OF STUDYING NATURE

BY LILIAN J. CLARKE, B.Sc., F.L.S.

[EDITORIAL NOTE.—The article reprinted below from *The Windsor Magazine* was sent by Professor Miall, of Yorkshire college, who remarks that this is a good sample of how some of the best teachers in England work directly with the actually living things, rather than with books.

Some of the work described is similar to that done in some of the best organized school-gardens in the United States and Canada. All the experiments are often done in our high-school botany. In fact this is work done by high-school pupils and in America would be scheduled as botany, with the outdoor work as supplementary nature-study.

The original article had numerous illustrations which it is not possible to reproduce here.]

The nature-study work at the James Allen's Girls' School, Dulwich, has been arranged so that the girls are encouraged to work for themselves, and study Nature by means of their own observations and experiments in garden, class-room and country. By these means they gain knowledge direct, and not from text-books, and it is found that knowledge thus directly obtained is of far more value to them than that acquired by listening to other people, or by reading in books what others have seen and done.

The school is fortunate in possessing a large garden, and for many years the girls have been allowed to own plots in it and be responsible for looking after them.

It would perhaps be well to state that the school is an endowed secondary school, and the girls are not being trained in it for any particular profession.

The special gardens were first started in connection with the plant nature-study lessons in the class-rooms, and only a few were owned at first by the girls; but as fresh branches of the subject were studied, the need for more gardens arose, and the head-mistress allowed more ground to be "annexed," and at present more than 140 girls own plots. Some of these plots are "order beds," in which only plants belonging to one family are grown, and some are devoted to carrying on experimental work in connection with the visits of insects and pollination, the production of starch by green plants in sunlight, and so on. Every year it is found that something more is needed in the school-gardens, and every year something is added. Gardening

is not a regular part of the school curriculum, so the work must be voluntary; but much enthusiasm is shown, and many applications are received for plots. The owners of the gardens are responsible for looking after them, and the necessary digging, weeding, watering, etc., is done in the dinner hour and after school.

Bacon, in his delightful essay on "Gardens," says: "God Almighty first planted a garden. And indeed it is the purest of human pleasures. It is the greatest refreshment to the spirits of man, without which buildings and palaces are but gross handiworks."

The practical work appeals to many who would not be interested in books, and in several cases has been the means of arousing a girl's interest in plant life. One set of students did not seem to take much interest in their work until they owned gardens, and then they were most industrious, and their gardens were beautifully kept. When photographs of the girls at work in their gardens were taken, one of these girls kept in the background, and on being told to come forward, exclaimed: "Oh, no; I should hide the sweet peas!" Unfortunately, in spite of this sacrifice, a good photograph of the sweet peas was not obtained.

The laboratories are near the gardens, and in fine weather a class often spends the time in watching insects visit flowers, in finding out the different methods by which plants climb, in studying the various ways in which seeds are dispersed, and in making experiments. There can be no doubt that when the weather renders it possible, it is far better for the children to study Nature in the open-air than in rooms.

Many experiments are carried on in the garden in connection with the visits of insects and pollination. Some plants are covered with muslin so that insects are excluded, and other plants of the same species are left uncovered. The students then carefully watch both sets to see if fruits appear on either. When fruits are found on both the covered and uncovered plants, the number and vigor of the fruits are compared, and in this way the girls are led to see that the visits of insects are an advantage to the plant. These experiments arouse great interest, not only in the owners of the plants, but throughout the school, and numbers of girls visit them to try and find out what is taking place.

In the watching of insects at work among the flowers, the students note, amongst other things, on what part of the flower the insect alights, what part of the insect is covered with the yellow dust or pollen, and how many flowers the insect visits in one minute.

Many clumps of flowers beloved by bees, etc., are grown in different parts of the garden, and the girls who own these plants seem to take a personal pride in the popularity of their flowers with the insects, and are often seen in the dinner-hour bringing other girls to watch what is taking place.

It is very amusing to watch bees visiting sage flowers. The bee alights on the lowest petal, which affords a good landing-place, and pushes its proboscis down the long throat of the corolla, and in so doing brings into operation a neat mechanical arrangement in the form of a lever. The bee touches two flaps which are really the lower ends of the two stamens, and at once the upper ends swing round, hit the bee on the back, and deposit thereon the precious yellow dust or pollen. The quick and sure way in which the upper part of the stamen strikes the back of the bee is a constant interest to all who watch, and on this account alone it is well worth growing salvias in the garden. The bee, with its back covered with pollen, visits another salvia flower, and coming in contact with a certain part, leaves some of the pollen on it, and in this way pollinates the flower and helps in the formation of seed.

The snapdragon, too, is a great favorite. A bee alights on the lowest petal, and with an effort opens the corolla, then enters it and disappears from view as the corolla closes. In a short time the corolla opens, and the bee comes out walking backwards, with its back covered with pollen

On visiting another snapdragon flower, some of the pollen is rubbed off and the flower is pollinated. In order that there may be ample opportunities of watching bees visiting flowers, we have a beehive in the garden, and some of the girls are much interested in studying the habits, etc., of bees.

Sometimes the bees attracted by the presence of flowers come into the laboratory, and on some occasions have been most useful in pollinating the flowers of plants growing in food solutions, and on others have excited great interest by pollinating cut flowers in the presence of a class.

The study of elementary classification is greatly helped by the plots in which girls grow certain orders or families of plants, and specimens for these plots are obtained by the girls when taking country rambles, or are sent to us by friends, old girls, etc. So far as space allows, the girls are at liberty to grow as many specimens of a particular species as they like, and the plots look gay with hollyhocks, sweet peas, wild roses, poppies, lilies, buttercups, foxgloves, etc.

It is the rule that to each plant shall be attached a label bearing the English name of the plant, so that the gardens may be useful to other students as well as to the owners.

It is a good thing that town people should see ordinary vegetables growing, and should know something about the methods of growing them, so the girls have in their gardens potatoes, onions, tomatoes, peas, beans, cabbages, lettuce. The owners take the greatest pride in producing fine specimens and in sending them in for the school dinner, and potatoes, peas, beans, etc., seem to acquire a great importance when it is realized that they have been produced in the school gardens. Last summer a girl owned eight tomato plants, the cost of which was 1*s*. 4*d*. The crop was a most successful one, and 21 lb. of tomatoes were picked from these eight plants growing in the open air. Most of the tomatoes were eaten at the school dinner, but some were taken by the girl who grew them to show her home people, and some were used in the cookery classes. The cookery mistress very kindly gave two demonstration lessons on different methods of cooking tomatoes, and these lessons were open to all girls except the very youngs ones. The girls were taught how to make tomato soup, tomato soufflé, tomato omelette, tomato chutnee, tomato jam, and galantine of cold meat and tomato. There was not sufficient sunshine in October to ripen the last of the tomato crop, and the green tomatoes had to be picked and brought indoors to ripen. As this must often happen in the case of tomatoes grown out of doors, special attention was given in one demonstration to showing different ways of using these tomatoes. Many of the younger as well as the older girls afterwards tried the various recipes at home, and there was a distinct danger that for a time their relations would have to eat too many dishes in which tomatoes played an important part.

All the girls were astonished to find how easy it was to grow tomatoes in the open air, and many determined to see what they could do in their home gardens next year. Some of the gardens are devoted to carrying on experiments in connection with the soil. The same crops are being grown year after year in the same ground, without any nourishment being given to the soil, and great interest is shown in watching successive crops. Also lupins are grown every year in the same plot, and beautiful specimens of roots covered with tubercles containing bacteria are obtained. Unlike most plants, lupins possessing tubercles on the root are able to use the free nitrogen of the air for food, and are not dependent for their supply of this element

on compounds in the soil. The soil, instead of becoming poorer, becomes richer year by year.

In the laboratory, the students make experiments and see that lupins grown in food solutions develop tubercles when brought into contact with tubercles on other lupins, and these flourish in food solution containing no nitrates, although (as the girls have already found out by means of other experiments) most plants without tubercles cannot live unless nitrogen, in the form of some compound, is given to them so that they can take it in by means of their roots. Other experiments in the garden are those in connection with the food made by green plants in the presence of light and carbon dioxide. Tests for starch are made on leaves growing in the light, and by the means of iodine, which turns starch dark blue, it is proved that green leaves in the garden make starch in the light, but make no starch if kept in the dark. Many of the students cut out their initials, or the word "starch," or anything they like, in any material easily bent, and, placing the stencil thus made over a green leaf, leave it for a day or two. The leaf is then picked, placed in alcohol to dissolve out the green coloring matter, and, by means of iodine, it is proved that the part to which the light had access has produced starch, but the covered part, to which the light did not have access, has not produced starch. For example: when the stencil "starch" is used, the "starch" comes out in dark blue letters on a yellow background.

In the autumn, the girls generally study fruits and the various methods of seed dispersal; and when they return after the long holidays, an excellent introduction to the subject is at hand. When first the girls, after their absence, look at their gardens, they find many plants which were never put there, and are certainly not in their right places. The question arises: "How did these plants come here?" and this leads the girls to see if there is anything in the formation of the fruit or seed which would fit it for being carried to a distance. They find that in some cases, as in that of the dandelion, the fruit is provided with a parachute which enables it to be carried easily by the wind. In other cases, as "burrs," the fruit is especially adapted for dispersal by animals. The fruit becomes attached to the animal by means of hooks, and is carried from one place to another until it drops off.

Other fruits, again, like those of the lime, sycamore, and maple, have wings which enable the wind to carry them. In some cases, as balsam, the fruit bursts with a loud noise and throws out the seeds

with violence to a considerable distance. The whole subject of the dispersal of fruit is so interesting that much time can be spent in discovering and in drawing different contrivances by means of which seeds can be carried away from the plant that produced them, and a better chance in the struggle for existence given to the seedlings.

In the garden, typical climbing plants are grown on structures which enable them to be seen easily. Wooden uprights are fixed in the ground, and the spaces between are covered with trellis-work or wire netting, and any girls who wish to do so grow climbing plants on these arrangements. All the girls can then study the habits of these plants for themselves, and see why the plant climbs, and how the different organs are used in climbing. In fine weather the girls come out into the garden and draw plants climbing by twining stems, by hooks, by roots, by tendrils.

The last piece of ground "annexed" by the students has been devoted to "plant associations"—that is, plants which live elsewhere under the same conditions of soil or climate. For example, a large plot has been given to "Alpine" vegetation, and with the help of others the girls have obtained for it characteristic plants such as the gentians, saxifrages, Alpine anemones, Alpine wallflowers, etc. It can then be seen how closely the plants resemble each other in stem and in leaf structure, although they belong to quite different families.

The same needs in their native place—namely, protection from the dry weather in summer, and from the frosts in winter—have developed similar arrangements in all; and it is interesting to see how by its compactness, its covering of hairs, and many other arrangements, the plant has been enabled to stand the climate. A garden plot has also been devoted to desert plants, but this is the most difficult plot of all, and there is not a large stock of these plants. In four or five other plots are grown other plants which previously lived in some particular locality or soil, and for some plots special soil have been obtained. The girls are thus able to study the characteristics of these plants, and in many cases to see how the plants adapt themselves to their environment.

In connection with all the subjects mentioned above—pollination, plant physiology, movements of plants, etc.—the gardens have been found invaluable, and incidentally many things have been learned. Some of the girls will long remember that mint propagates itself by means of other structures than seeds. The owners of one plot spent many weary hours trying to root up the mint which monopolized their

garden, although originally there had been only one plant; but by means of underground stems the plant had made scores of new plants.

It is not always possible, however, to go out into the garden, and a room has been built and arranged so that experimental work can be carried on in-doors throughout the year. It is the first of its kind, and resembles a greenhouse in having a glass roof and in being kept at a constant temperature during the winter months, but in other respects it is more like a laboratory. On three sides of the room are benches at which the girls draw from Nature, fit up experiments, etc. The side of the room without benches is fitted with a sink, draining-board, blackboard, and a tank.

The tank is eight feet long, two feet wide, and one and a half feet deep, and the side facing the room is made of glass. Arrangements have been made so that rainwater can enter it, and when necessary the tank can be emptied by means of a tap at the bottom. The tank was made in the room in order that the girls while in school, might study living water plants, and in the summer there are growing in it water-lilies, water-milfoil, water-plantain, water-hawthorn, vallisneria, frogbit, iris, rushes, and water-crowfoot. In the tank artificial marshes, or bogs, have been made, and in these are grown plants which are not accustomed to living in water, but which need more water than is found in most soils. Two trays, four and a half inches deep, filled with earth, and with perforated bottoms, are supported on four legs, and screws are arranged so that the level of the trays can be adjusted and the tray be either in or out of the water.

Most of the plants in one bog-garden were sent from Killarney, and thrive well in their new home. Butterworts, bog-bean, bogarum, wood-sorrel, mare's tail, and forget-me-nots are flourishing. The butterworts are especially interesting and are a great success. These plants are insectivorous, or carnivorous—that is, are dependent for part of their food on the insects they catch. As stated above it is necessary, in order that plants may live, that they should obtain nitrogen in some form or other, and most plants obtain it in the form of compounds from the soil by means of the roots.

Plants that have defective roots, or that live in poor soil, cannot obtain nitrogen in the usual way, and some are specially adapted for attracting and entrapping insects, and afterwards digesting the substance of their bodies. The British insectivorous plants are butterworts, sundews, and bladderworts, and in the laboratory bog-garden the butterworts catch insects in a way that would be condemned by

the Society for the Prevention of Cruelty to Animals. The plant consists mainly of a rosette of glistening leaves touching the ground, and these leaves are at once the means of attracting, retaining, and digesting the insects. The margins of the leaves are slightly incurved upon the upper surface, and there are present two kinds of glands — one that manufactures a sticky fluid, and the other that manufactures a digestive fluid resembling in properties the gastric juice found in animals. When an insect alights on a leaf, the edges of the leaf slowly curl over, a quantity of sticky fluid is poured out, and the insect is kept a prisoner. The presence of the insect also causes a quantity of the digestive fluid to be poured out, and soon the body of the insect is dissolved and digested, and only a few indigestible parts left. The name "butterwort" was given to the plant because it was found that its leaves when placed in milk curdled it. In South Wales, butterwort leaves have been used as a substitute for rennet, and Linnæus states that the Lapps used it for curdling milk.

The other bog-garden represents a piece of Dartmoor. Sundews, marsh red-rattle, asphodel, and many other plants brought from Dartmoor are growing in it, and some soil was brought with the plants, in order that they might grow in their native soil. [At this place in the original article the writer describes well-known laboratory experiments such as measuring plant growth and testing influence of light and gravity.]

Many people are familiar with an incubator in which chickens are hatched, but not with one in which seeds are germinated. So many seedlings are wanted for different purposes by the girls that a seed-incubator has been made, in which seeds can be quickly germinated. Some of the girls draw the seedlings, some use them for experiments in connection with the influence of light on growth, and some place the seedlings in food solutions. The food solution consists of water in which definite quantities of certain chemicals have been dissolved[1]. A normal food solution contains all the food a plant needs, and there are in the laboratory at the present time oaks, seven years old, which were grown from acorns, and have never been in soil. The biggest one measures four and a half feet from the bottom of the roots to the top of the stem, and has about twenty branches.

Other interesting perennials in food solution are sycamore, beech, birch, chestnuts, hazel, and hornbeam. Every autumn they lose their

[1] Evidently the solution described in Vol. I, No. 2 of THE NATURE-STUDY REVIEW.]

leaves, and look like miniature dead trees, but in the spring the buds begin to swell, the bud-scales to open, and the leaves to unfold. It is most fascinating to watch the unfolding of the buds, and the girls are able to note and draw from nature the successive stages of bud development, even when they are prevented by the weather from going out into the garden. The girls are allowed to grow in solution any plants they like, and in summer there are more than one hundred such plants. Beans sixteen feet high have been grown, and some plants have produced flowers and seeds. The seeds are carefully kept, and sown the next year in sawdust; and if the plant of the second generation in solution produces seeds, these are also treasured until the next year, and so on. There are some plants at present in solution whose pedigree has been kept, and whose ancestors for six generations have been grown in food solution.

Experiments are made by the girls to find out what elements are necessary, and solutions are made up without iron, or without potassium, etc., and the effect on the plant noticed. It has been said that the results of growing plants in solution are often unsatisfactory, but this has not been the case at Dulwich. The plants live when they ought to live, and die when they ought to die. In the course of a series of experiments extending over six years, not one case was noted of a plant in normal food solution dying unless it had received some injury to its root or stem.

Details have now been given of the work carried on by the girls in the garden and laboratory, and a few words must suffice to describe the excursions. These take place throughout the year, and before the girls start on an expedition some definite piece of work is given. Sometimes they study plants on a heath or plants in a cornfield; sometimes they study trees. Many people find it difficult to identify the common English trees in summer, and much more difficult in winter; so the girls study trees in spring, summer, and winter, and learn to identify them by the bark, buds, nature of branching, etc.

By means of the work carried on indoors and out of doors, the girls are led to observe, to experiment, and to draw conclusions, and in this way the study of Nature, in addition to the pleasure it brings, affords a mental training to all who take part in it.

As Ruskin says: "To watch the corn grow or the blossoms set; to draw hard breath over ploughshare or spade; to read, to think, to love, to pray—these are the things that make men happy."

NOTES ON ANIMAL BEHAVIOR

BY ARTHUR W. WEYSSE

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[EDITORAL NOTE.—The following from a scientific journal deserves a place in THE REVIEW because teachers of nature-study are so often face to face with problems of animal behavior.]

It has been suggested to me that it would be worth while to put on record two or three rather curious instances of animal behavior which have come to my notice during the past few weeks. The subject of these observations is a two-year-old black-and-tan terrier belonging to my sister. A few weeks ago as the family was at dinner one evening my mother said, "What did the postman bring this afternoon?" "Only a couple of advertising cards," said my sister, "which I threw in the waste-basket." Nothing more was said on the subject, but a moment later the dog, who had been sitting on a chair in the same room, ran to the basket, and taking one of the very cards referred to in his mouth, ran around the table and stood with it beside my mother, looking up into her face and wagging his tail. I fear that some of our popular writers on animals would at once attribute a rather remarkable reasoning power to this dog, saying that he thought my mother would like to see the card, and so selecting it from the others in the basket took it to her and expected to be rewarded for his thoughtfulness. But there is a much more reasonable explanation. He is still very playful, and as he jumped from the chair and ran about the room the card projecting above the edge of the basket caught his eye, and the play instinct prompted him to seize it. The fact that he did this just after my sister had spoken of the card was a mere coincidence. His running to my mother with the card is easily explained. Several months ago, while he was still a puppy, he frequently pulled papers from this same basket and was punished for doing so, until he entirely gave up the habit. As soon as he had taken the card from the basket, the memory of former punishments for similar acts doubtless recurred to him. Now my mother is intensely sympathetic, and whenever he is punished or likely to be punished he invariably runs to her, knowing that he will be petted and may even get a lump of sugar; if the recollection of

punishment came to him, he would naturally follow his habit and run to her.

It was about a week after this that my sister sat in the same dining room later in the evening reading a book, while the dog, who is as restless as dogs of that variety usually are, was running about looking for something to play with. At last my sister said, without looking up from her book and in an ordinary tone, "Teddy, if you go down cellar and bring up a stick of wood, I'll play with you." The dog stood beside her as she spoke and immediately darted out into the kitchen, down the stairs into the cellar and soon reappeared beside my sister with a stick of wood. This was not a trick he had been taught. He has several times during the past winter carried sticks of wood from the cellar to the kitchen, and at times has been praised with such words as: "Nice dog to bring up wood from the cellar." But this carrying the wood has always been done voluntarily. Different members of the household when in the cellar have told him to carry up sticks, and he has never done so; sometimes a stick has been put in his mouth in the cellar, but after taking it as far as the stairs he would drop it and run up alone. He has been told a few times to go to the cellar and bring up a stick, but no attempt has been made to teach him to do so, and he has never done it except in the instance noted above. Since the evening in question the same remark has been made to him several times, and he has not responded to it in any way. The explanation would seem to be that he had learned to associate the words "cellar" and "stick" with the objects themselves and probably the word "play" with the corresponding activity, for my sister plays with him a great deal and on such occasions frequently repeats the word "play," as "Now let us play" or "Come, play with your ball." At the time in question the play instinct acted as a strong stimulus, probably a "felt-need" from within, such as I have referred to in my text-book, and hence the special response. The whole act, then, involves no factors more complicated than memory and the association of names with objects, a faculty which dogs possess in considerable degree.

This same terrier, for example, associates the word "ball" with the corresponding object with which he plays. If someone is in the pantry and you say to him, "Go to the pantry and they will give you a piece of dog-biscuit," he invariably goes for it, as he has doubtless learned to associate the words "biscuit" and "pantry" with the objects themselves. In the same way if you say to him, "The grocer is coming

into the kitchen to take orders; you must stay here in the dining room,'' he invariably does so, although he is always very eager to see and jump upon any person who enters the house. The simple words, ''Grocer! stay here!'' will have the same effect in keeping him out of the kitchen. He has likewise learned to associate the words, ''He is coming,'' with the approach of anyone to the house. I generally go home only on Sundays and at variable hours, and if the house is quiet my mother sitting in the drawing room can say quite softly, ''I believe he is coming,'' when the dog, two or three rooms distant and apparently asleep, will start up and run from window to window, looking up and down the street. He will do the same on any other day and for any individual, but with some variation in the rapidity of his response I record these acts merely to show that while they might superficially appear to be the result of reasoning processes, they are doubtless only instances of memory and the association of spoken words with the objects or acts. [From *Science*, N. S., Vol. XIX., No. 495, Pages 955–957, June 24, 1904.

Boston University. Arthur W. Weysse.

EDITORIALS

NATURE-STUDY LEAFLETS

In reply to several letters the managing editor has written that The Nature-Study Review does not in the least compete with the many excellent leaflets issued by State Departments of Education, Experiment Stations, certain colleges, and the U. S. Dept. of Agriculture. These leaflets are usually intended for beginners in nature-study teaching. Since from the beginning The Review has been primarily a magazine for those who are working for the progress of nature-study, it can not undertake to give to beginners the detailed instruction, which they need. This is the field of leaflets for local use, the existing books, and the educational journals published in each State.

YOUR SUGGESTIONS ARE WANTED

The managing editor will appreciate the help of any reader who will write criticizing the general plan of the 1906 issues and give suggestions for 1907. A similar note last year brought many helpful letters from subscribers.

BEST BOOKS FOR NATURE-STUDY

Letters concerning the article with this title in the May issue are still coming to the editorial office of THE REVIEW. We hope to have many more selected lists and comments on those published in time for publication in March.

WEAKNESS IN NATURE-STUDY

Concerning the article with this title in the October REVIEW many letters have been received, some agreeing with Dr. Hornaday and others strongly opposing his views. If you have opinions which you think worth defending, send them at once for publication in a series of discussions in the February issue. The subject is one of the most important which have been discussed in this Journal, and we need enough letters to show the general trend of opinion.

TYPES OF THE BEST NATURE-STUDY

Under this general heading we plan to publish next month a paper by Professor Hodge on "Practical Work with Mosquitoes." Concerning this paper Professor Hodge writes as follows: "The plan in a word is to call out from the whole circle of REVIEW readers the best bit of practical nature-study teaching each has done during the past year. The question is: What ha' ye DONE? How did it go? I find everywhere I go that it is this question the teachers want to have answered. We certainly have been up in the clouds long enough and I think this general reaction is the most hopeful sign for the future of nature-study I have seen."

Undoubtedly many readers could help answer the above questions. If you have worked out any practical lessons new to your school, send your results to THE REVIEW.

NOTES ON PAMPHLETS AND MAGAZINES

Bird Migration and Geography. The intimate relation between nature-study and geography is shown in an article on "Migration of birds as a subject for geography study," by Spencer Trotter, in the *Journal of Geography* (April, 1906).

Cultivation of Food Fishes. Fifty species are now cultivated by the U. S. Bureau of Fisheries. The list includes salmons, trouts, whitefishes,

graylings, catfishes, buffalo-fish, shad, pickerel, basses, perches, tautog, cod, flounder. More than one and one-half billions of young fish were raised and distributed in 1905. [B. of F. Document No. 602].

Preparation for Nature-Study Teaching. Dr. Goodwin, in charge of secondary schools in the State of New York Department of Education, writes in the *Educational Review* as follows:

"An incidental feature of the revised syllabus [for high schools] is a one-year course in biology consisting of some study of botany, zoology, and human physiology. Its unity is insured by the special emphasis given to the study of the vital processes that characterize both plants and animals. It is elementary and therefore adapted to the first year. It aims at scientific teaching, but not comprehensive knowledge. It is to be a required subject for all students in secondary schools who expect to prepare for teaching in any of the twelve normal schools or fourteen city training schools within the State of New York. There is a double design in this requirement. The first is to arouse the student's sympathy for animate objects, to develop his power to make accurate observations, to train him to make an intelligible record of his knowledge, and to prepare him for subsequent science-study in the secondary school. The second is to make "nature-study" successful in the elementary schools, by qualifying teachers to give instruction in this subject.

Alcohol. Concerning the use of alcohol for industrial purposes there is now widespread interest, and to meet the demand for information Farmers' Bulletins 268 and 269 (free) have been issued by the U. S. Department of Agriculture.

Boys and Girls Magazine. Recent numbers of this monthly, edited and published by Martha Van Rensselaer, Ithaca, N. Y., are full of interest to active, wide-awake boys and girls and their teachers. Excellent lessons in nature-study are regular features. If you have not seen this little magazine, send a postage stamp for a sample copy.

Nature and Science for Young Folks. This department, which Dr. E. F. Bigelow has been conducting in *St. Nicholas* for five or more years, continues to keep up to the high standard set in the first years. Without the knowledge of the editor and publishers, the writer of this note has quietly inquired concerning the interest of children in this department and the uniform testimony of parents and teachers makes it clear that a popular magazine can do much valuable work as a teacher and inspirer of nature-study. It is unfortunate that so many families cannot afford to subscribe for *St. Nicholas*, but teachers of nature-study ought to show copies to their pupils and encourage them to read the "Nature and Science" department at the

public libraries. No doubt the publishers would gladly send out a sample copy to teachers who would promise to make such good use of it.

Home Nature-Study Course. The 1906 leaflets of this interesting correspondence course conducted from Cornell University by Mrs. Comstock contain good lessons on butterflies, fish, flowers, trees, birds, beans, American silk-worms.

Seeds and Seedlings. The September *Plant World* contains a suggestive outline study of seeds and seedlings, by Dr. C. Stuart Gager of the New York Botanical Garden.

Imported Fibres to the value of $148,000,000 were used in the United States in 1905. Fine grades of cotton, chiefly from Egypt; manila, chiefly from the Phillipines; sisal grass, chiefly from Mexico; and jute from India are the most important fibres. [Report U. S. Dept. Agriculture.]

NATURE-STUDY AND SCIENCE NOTES

[EDITORIAL NOTE.—Many replies to the note at the head of this column in September have convinced the managing editor that this department is wanted by many readers. The following note from a letter is typical of those received from several prominent teachers in normal schools and colleges:

"I wish to say that as a teacher of nature-study I have found the Nature Notes and especially the reviews of current periodical literature to be of the highest value. I should be very glad to see them both expanded, so long as their present quality is not deteriorated, and should consider it a distinct loss if those departments were permitted to disappear."

Some of the notes now appearing are signed with the initials. As soon as the list of regular contributors is complete the full names and addresses will be published.]

National Department of Health. A paper in a recent issue of *The Journal of the American Medical Society* makes a plea for the establishment of a national department to consolidate and unify work, such as the Marine-Hospital Service and the pure food work of the Agricultural Department, now being done by various bureaus.

Hydrophobia is regarded by some physicians and surgeons as a simulated disease. While this allegation is by no means generally accepted, it is interesting to note the claims put forth by those who believe the newspapers have printed too much that is sensational about mad dogs. There is in a recent number of *Our Dumb Animals* a statement that at the Philadelphia

dog-pound 6,000 vagrant dogs are taken up annually, and not one case of hydrophobia has occurred there during the past 25 years. A well known specialist, Dr. E. C. Spitzka, of New York, is quoted as saying that much of the observation of suspicious dogs is made through optics disturbed by fear. Prominent professors in various medical colleges in Philadelphia, New York, etc., express the opinion that communities are often unduly alarmed over the supposed danger of dog bite.

Immunity against tuberculosis. In a recent number of the *Central blatt fur Bakteriologie* Dr. S. Metalnikoff discusses a possible means of acquiring immunity from consumption. In experiments he found that the caterpillar of the bee-moth is immune against the forms of tuberculosis found in man, cattle and birds. The caterpillar possesses a special kind of ferment which by experiment was found to be the active principle in resisting tuberculosis. A preparation was made from the blood of the caterpillar, and tuberculosis guinea pigs were treated with quite satisfactory results. [*Review of Reviews*, 34: 240–241, Aug. 1906,] E. A.

Chipmunks Climbing Trees. Concerning this there seems to be decided difference of opinion, if one may judge from many letters recently published in a New York newspaper and quoted in *Shield's Magazine* for October. There is also considerable variation in answer to the questions whether chipmunks chatter and whether they leap from tree to tree. It is also clear that many people do not distinguish between red squirrels and chipmunks.

Prickly Pear for Cattle. Bulletin 91 of the Bureau of Animal Industry deals with experiments in feeding prickly pear cactus to cattle in Texas. Cattle readily eat the cactus which has been singed with a gasoline torch. Machinery for chopping and crushing is now in use on some ranches.

Fur Supply. It is commonly believed that the fur-bearing animals are rapidly being exterminated, especially in Northern Canada where for two hundred years the fur trade has been active. According to a recent consular report, the supply is still far from exhaustion. The Hudson Bay Co., which no longer monopolizes the fur trade, reports a great decrease in beaver, sea-otter, raccoon and silver fox as compared with forty years ago. The buffalo (bison) skin has completely disappeared from the market. There has been a great increase in number of skins of bear, ermine, red fox, martin, lynx, muskrat, rabbit, skunk. The number collected annually is influenced by the demand, but with the exception of the animals which have for years been rare, the latest reports indicate that such animals as badger, bear, ermine, red fox, white fox, martin, mink, muskrat, rabbit and skunk are still plentiful. Hunters report that there are still vast unexplored regions

where the common furs are as abundant as they were in the regions known fifty years ago. Apparently the fact that the trappers are continually moving on to new regions and thus giving the animals a chance to multiply in regions once hunted is the explanation of the continuous supply.

Birds and Boll-Weevils. A recent pamphlet from the Department of Agriculture states that 28 species of birds feed on the boll-weevils of cotton. Orioles are most important in summer; blackbirds and meadow larks in winter. Unfortunately the demand for their bright plumage for millinery purposes has greatly reduced the number of orioles.

Salt in New York State. All the salt wells in the State obtain their brine from the same rock-salt deposit in the Upper Silurian. Rock salt is now mined at a depth of 1,270 feet from a bed 70 feet in thickness. The Syracuse wells have produced over 12 million tons since 1788. [*Science*, Aug. 24, '06.]

New Game Laws. Sale of protected game is prohibited now in Mississippi, Michigan, Minnesota, Missouri, Arkansas, Kansas, Texas, Montana and Arizona. Arkansas, Alabama and Texas are the only regions in the United States and Canada where there are no game-wardens. Canada in 1905 established a game preserve of 2,500 square miles in the Province of Alberta. Congress ordered a lease of 3,500 acres for buffalo pasture in South Dakota and established a game refuge in the Grand Canyon Forest Preserve in Arizona. Farmers' Bulletin 265 (free from Department of Agriculture, Washington, D. C.) gives full details.

Alfalfa and Bees. On one farm where no bees were kept the yield of seed, in 1905, was two bushels to the acre. On another farm, on the same bottom, one mile from the first, where only three colonies of bees were kept, the yield of alfalfa seed was between four and five bushels to the acre. On still another farm, where about twenty colonies of bees are kept, the yield was between seven and eight bushels per acre; and two miles below, without bees, the yield again dropped to two bushels. [*American Bee Journal.*]

Height of Birds in Flight. By pointing an astronomical telescope towards the moon on clear nights in the seasons of migration birds may often be seen as dark objects passing rapidly across the bright back-ground. Professors Stebbins and Carpenter, at the University of Illinois, have been making observations by means of two telescopes set so that simultaneous observations of a bird makes it possible to get measurements necessary for computing the height of the bird above the ground. Eighteen birds were measured. Only one was one mile high; the majority were less than one-half mile; one was 1,200 feet high. Most works on ornithology estimate the elevation of migrating birds at one to three miles. [*Popular Astronomy*, Feb., '06. *The Auk*, April.]

Rotten Wood for Watchmaking. The finest Swiss and French watches, especially the small screws and the escape parts, are still polished by hand and rotten wood. In Switzerland it is estimated that $4,000 worth of rotten wood is used annually for this purpose, the best quality costing one dollar per pound. Not only the species of wood but the species of fungus causing the rot is determinate in producing the desired result, namely, a yellowish-white, silky wood, soft and spongy, brittle and of feather weight, and the annual rings still visible. [From *The Forestry Quarterly*, September, 1906.] J. B.

Oysters and Typhoid. A series of experiments by Prof. Klein in the Metropolitan laboratory in London shows that the oyster exerts a positively bactericidal and anti-septic action on the typhoid germ. The superstition in regard to eating oysters during those months without an R in their names is without foundation. [*Review of Reviews*, 34:381, September, 1906.] E. A.

Timber for Wood Pulp. Circular 44 of the Forest Service states that over three million cords of wood were used for paper pulp in 1905. 1,300,000 cords came from New York State. Less than 2,000,000 cords were used in 1899. Spruce was used for 70 per cent, poplar and hemlock each about 10 per cent of the total. It is estimated that in New York the supply of timber for pulp will last less than twenty years, in Maine fifteen years and in the other States producing less pulp from thirteen to thirty years. Progress in making pulp from sawmill waste, such as sawdust, is being made.

NEWS NOTES

Professor Burkett, one of the authors of the well-known "Agriculture for Beginners" has resigned from the Agricultural College at Raleigh, N. C., to accept the directorship of the Agricultural Station at Manhattan, Kan.

Professor Davis of the Chico (Cal.) normal school will early in January take up the nature-study work in the college for teachers in Miami University, Oxford, O.

North Carolina Nature-Study. Prof. and Mrs. F. L. Stevens are conducting regularly a very practical nature-study department in the new *N. C. Journal of Education.*

Traveling Libraries and Nature-Study. Through the Andrew

Carnegie Free Traveling School Libraries elementary nature-study has been introduced into 800 or more rural schools of the south. Efforts are being made to establish school-gardens in connection with the nature-study course; 47 are already established, giving satisfactory results to both teachers and pupils. As far as possible these schools are supplied with seed and plants by this system of traveling libraries.

Massachusetts Instruction in Agriculture. The last session of the legislature appropriated $5,000 to promote agricultural instruction in elementary grades. The movement will be centered in the State agricultural college.

Georgia Agricultural High Schools. Eleven schools will be established as feeders for the State College of Agriculture. A farm of at least 200 acres will belong to each school. The boys will do all the work on the farms and receive wages from the proceeds of the farms.

Maryland Instruction in Agriculture. A new law requires that agriculture must be taught at least one year in the public school course.

Michigan Nature-Study League. In October, an association called the Nature-Study League of the Michigan Agricultural College, was organized with the following staff of officers: president, Dr. J. B. Dandeno; vice-president, Miss Rachel Benham; secretary, Mr. E. P. Robinson; treasurer, Miss Bertha Lunn. The object of the League is two-fold: (1) to enable those who expect to become teachers to gather ideas in regard to material and methods, which will be helpful in the work of teaching along the lines of nature-study. (2) to enrich the knowledge of students and others with respect to things and phenomena of every-day life, and to create an appetite for investigation.

It is further expected to hold all members whether absent or present, resident or non-resident, in an intimate relationship with regard to nature-study, so that the League may give and receive assistance by correspondence concerning local and reasonable conditions. The League meets once a week, on Tuesday evenings from seven to eight o'clock. Communication with other nature-study associations is invited.

Professor R. O. Johnson will take charge of the Nature-Study work at the Normal School at Chico, Cal.

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